Learning from the Best:

Palaeo-Inuit Novice Flintknapping on Southern Baffin Island

By

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Abstract

This thesis investigates two aspects of Palaeo-Inuit lithic quarry use in the eastern Arctic. The first is the place of the LbDt-1 quarry in the established lithic reduction continuum on southern Baffin Island and to investigate how Palaeo-Inuit peoples structured their use of this site. The second is the social role of LbDt-1 as a place where novice flintknappers had their first opportunity to gain practical experience breaking rocks.

A multi-method approach that combines individual attribute and aggregate analyses is applied to the lithic debitage from LbDt-1. The results indicate that lithic activities at LbDt-1 were limited to the earliest stages of the lithic reduction and a high frequency of novice mistakes point to use of the site by inexperienced flintknappers. Comparison of the LbDt-1 debitage assemblage to extant data from four Pre-Dorset habitation sites located in the interior and on the coast (Milne 2003) indicates a higher frequency of novice errors at the quarry and the two interior sites compared to the coastal sites. This suggests that the LbDt-1 quarry, and the interior region more generally, was the preferred location for novices to gain experience in flintknapping. Further, the debitage patterns identified at LbDt-1 represent only the earliest stages of lithic reduction and lack evidence of tool production. In this way, the LbDt-1 assemblage does not resemble a typical quarry, and contradicts the expectation of the field processing model that a quarry located at a significant distance from habitation sites would have debitage from the full reduction sequence (see Beck et al. 2002). Lithic activities at LbDt-1 did not emphasize efficient chert extraction, but rather the social decisions made by Palaeo-Inuit people, who had determined that the interior was the appropriate place for teaching novices to flintknap (Milne 2014:110). The abundance of chert available in the interior compared to on the coast was no

doubt a significant determinant in the association of the interior region with chert procurement and novice learning (Milne 2003, 2005, 2014).

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1. Introduction

Over the last four decades lithic debitage studies have become more common and sophisticated as the analytical and statistical methods used to study these artifacts have advanced. Today it is widely accepted that debitage has an important role to play in our understanding of past human lifeways. Debitage studies provide unique insights into past human behaviours because as a "waste product" lithic debitage tends to be left where it was produced, unlike stone tools, which were transported between sites and often discarded far from where they were made (Ahler 1989a:86; Magne 1989:15; Odell 1989:163). This means that by studying debitage, specific lithic activities can be isolated at certain places on the landscape. As such, the movements of people in the past can be traced by connecting these sites based on their debitage signatures, either through the reduction stages represented at each site or by geochemical sourcing methods (Nelson 1991:79; ten Bruggencate et al. 2015). One great advantage of studying lithics is that they very rarely, if ever degrade the way organic materials do. This permanence makes the lithic debitage and tools left behind by past peoples small behavioural snap shots, providing detailed information regarding the techniques used to produce a stone tool or debitage assemblage, as well as information regarding the skill of a flintknapper (Cotterell and Kamminga 1987; Hayden and Hutchings 1989; Milne 2005; Shelley 1990).

In the eastern Arctic, lithics are often the only remaining evidence that Palaeo-Inuit people had occupied a site, owing to poor preservation in certain regions (e.g., the low Arctic) and time periods (Milne and Park 2016). The Pre-Dorset entered the eastern Arctic near the end of the Postglacial Warm Period (McGhee 2001:110). The warmer climate during this period resulted in inconsistent permafrost depths, which led to patchy preservation of organic materials deposited by Pre-Dorset peoples (Dekin 1972:15). This poor preservation is further complicated by the Low Arctic environment, which is where most Pre-Dorset sites have been identified. This region has more vegetation, moisture, and acidic soils than in the High Arctic, all of which contribute to the decay of organic materials. As a result Pre-Dorset sites often lack the environmental conditions that promote the excellent preservation that characterizes later Dorset and Thule sites (Maxwell 1985:34; McGhee 2001:8). However, a better understanding of the organic components of the Pre-Dorset toolkit may be forthcoming as recent investigations of interior Pre-Dorset sites on southern Baffin Island indicate that preservation in this region is superior to the wet coastal regions, as evidenced by sites producing large, well-preserved faunal assemblages and delicate bone and ivory tools (e.g., Landry 2013; McAvoy 2014; Milne and Donnelly 2004). This generally poor preservation of Pre-Dorset material culture has made lithic artifacts the main source of our knowledge of Pre-Dorset peoples (Maxwell 1976:58; Milne and Park 2016:695).

1.1 Background

The earliest inhabitants of the eastern Arctic were the Pre-Dorset, who first entered the region around 4500 B.P. (Milne and Park 2016:693–694). After nearly 2000 years of occupying the eastern Arctic, at around 2700 B.P., the Pre-Dorset altered their technology, possibly to adapt to colder environmental conditions, and developed the culture known to archaeologists as the Dorset (Maxwell 1985:122–125). Collectively these two temporal phases of the same culture are referred to as "Palaeo-Inuit." One hallmark of Pre-Dorset culture is their "dual-economy," which required a highly mobile lifestyle, that included moving seasonally between the coast and the interior regions to take advantage of subsistence resources as they became available (Milne 2003a:60; Milne and Park 2016:696). In contrast, the Dorset are typically characterized as a more sedentary people who lived on the coast, focused their subsistence activities on marine resources, developed storage technologies that allowed them to remain in one location for longer, and started building more permanent dwellings (Maxwell 1985; McGhee 2001:130; Milne et al. 2012:272; Ryan 2016:770). However, Dorset sites identified in the interior region of southern Baffin Island have demonstrated that, in this region at least, the pattern of seasonal coastal-inland mobility practiced in the preceding Pre-Dorset period continued throughout the Dorset period (Landry 2013; Milne et al. 2012).

Previous research has argued that the persistence of seasonal long-distance travel throughout the Dorset period on southern Baffin Island can be directly attributed to the geological localization of chert sources (Milne et al. 2012, 2013). Chert is the primary raw material used by all Palaeo-Inuit toolmakers, and on southern Baffin Island this material can be found in abundance in the intermediate zone and deep interior where it formed as a precipitate in the limestone bedrock. The geological composition of granite-gneiss bedrock on the coast does not likewise form chert, thus Palaeo-Inuit people had to travel long distances to acquire this necessary resource (Milne 2005:338; ten Bruggencate et al. 2016:686; Stenton 1991a:20–21). Although this required movement from the coast to the interior was arduous, it was incorporated into their lives and was likely an event that was eagerly anticipated as it offered an opportunity to add variety to their diet, visit with distant friends and relatives, meet potential spouses, enculturate young people and teach them flintknapping skills, and to reaffirm connections to the land through travelling (Milne 2014:109–111; Milne et al. 2013:55–57).

1.2 Research Questions

This study examines lithic debitage collected from LbDt-1, a Palaeo-Inuit chert quarry located in the interior region of southern Baffin Island, to investigate questions related to chert procurement strategies and the acquisition of flintknapping skill. The LbDt-1 quarry is an ideal place to investigate procurement strategies because this site type represents the first stage in the use-life of a stone tool, where raw material was tested and selected for further reduction elsewhere (Landry et al. 2020:155). LbDt-1 is also an appropriate site to investigate novice flintknapping as quarries have frequently been cited as the best educational setting for novices to learn due to the abundance of raw material at these locations, which would have allowed for experimentation without depleting their group's supply of raw material (Bamforth and Finlay 2008:17; Ferguson 2008:54; Finlay 1997:209; Goldstein 2019:685; Milne 2014:108).

The first goal of this research was to identify the lithic reduction techniques and stages represented at LbDt-1. This question was investigated using the combined methods of individual attribute and aggregate analysis to identify stage-specific reduction patterns within the debitage assemblage. These patterns provided the necessary information to identify the technological strategies used by Palaeo-Inuit people at LbDt-1 and to identify microscale differences between spatially separated components within the site. Once identified, debitage patterns were compared to those previously reported by Milne (2003a) at four previously investigated sites on southern Baffin Island. The comparisons provided the necessary data to make macroscale interpretations regarding where LbDt-1 fits within the regional lithic reduction sequence of southern Baffin Island.

The second objective was to investigate the social significance of chert quarries on southern Baffin Island as locations where expert Palaeo-Inuit toolmakers taught novices their craft. This topic was investigated through individual attribute analysis to isolate patterns associated with unskilled flintknapping using attributes identified through previous experimental and archaeological investigations of lithic reduction and novice skill (Cunnar 2015; Milne 2003a, 2005; Shelley 1990). Following this, the data derived from the analysis of LbDt-1 were compared with existing data (collected by Milne 2003a) on lithic assemblages from two interior habitation sites - Mosquito Ridge (MaDv-11) and Sandy Point (LlDv-10), and two habitation sites located at the head of Frobisher Bay on the southeast coast of southern Baffin Island Tungatsivvik (KkDo-3) and Shaymark (KkDn-2). Previous comparisons of the debitage patterns identified at these four sites indicate a spatial separation of skill across the landscape between these locales (Milne 2003a, 2005, 2012). The comparison of novice activities identified at LbDt-1 to the four habitation sites, allowed for exploration of the role of Palaeo-Inuit novices in lithic procurement and transport.

The results of the LbDt-1 debitage analysis and how it relates to patterns observed in Milne's (2003a) data were interpreted using the theoretical frameworks of the organization of technology and agency theory. This analysis allowed me to develop a broader regional interpretation of how novice flintknapping activities were organized, technologically and socially, across multiple scales depending on proximity to known chert sources. The identification of where on the landscape novice activities occurred enhances our current understanding of Palaeo-Inuit social organization, the social relations of lithic production, skill acquisition, mobility, and settlement patterns, as they are influenced by the seasonal and geological availability of chert.

1.3 Significance of Research

This is the first detailed debitage study conducted on materials from a chert quarry in the eastern Arctic. Milne's (2003a, 2005, 2012) earlier interpretations of the lithic reduction sequence on southern Baffin Island have provided a good understanding of how chert was transported and used across the landscape (Milne 2003a, 2012). However, when this research was conducted, the first stages of lithic reduction could not be explored as no chert quarries had yet been identified. The incorporation of data from the LbDt-1 quarry provides this missing first stage of the lithic reduction continuum. The identification of lithic reduction patterns specific to LbDt-1 provide data that can be compared to models that predict expected behaviours at quarries (e.g., Beck et al. 2002; Gramly 1980; Shott 2015). Using these patterns, I was able to assess if the activities represented at LbDt-1 were typical of what is expected for a quarry, especially one located at a significant distance from habitation sites and in an area where chert is unevenly distributed across the landscape. Past lithic research has generally avoided studying quarries due in part to the overwhelmingly massive size of lithic assemblages that are produced at quarries, their lack of stratigraphic differentiation, and the absence of diagnostic artifacts (Beck et al. 2002:481–482; Landry et al. 2018; Singer 1984:35). These characteristics make quarries difficult to date, and the vastness of the sites and their assemblages are often viewed as too cumbersome to study compared to their information potential (Beck et al. 2002:481–482). However, if we are to gain a complete understanding of the technological organization of a group lithic studies must include data from quarries (Burke 2007:63; Ericson 1984:1; Singer 1984:35).

My research focusing on the LbDt-1 quarry site adds to the growing archaeological understanding of this site type in general, and builds on Milne's earlier works (2003a, 2005, 2012, 2014), which investigated the importance of the interior region of southern Baffin Island to Palaeo-Inuit people as the location where chert could be procured, and as the place where novice stone workers were provided the opportunity to flintknap.

The second research objective highlights the social significance of quarries such as LbDt-1 as early "classrooms" where expert tool makers transferred their skill and knowledge to the younger generation. Investigation of this topic allowed for the consideration of what affects communal learning practices taking place at quarries might have on a group's overall technological organization considering things such as scheduling of novice flintknapping apprenticeship, tool standardization, enculturation, strengthening of intergenerational bonds, and the reinforcement of relationships between dispersed communities (Goldstein 2019; Milne 2014).

1.4 Organizational Framework

This thesis is organized to provide the necessary background, theoretical, and methodological information in the earliest chapters. These background chapters are followed by those that are focused on describing and interpreting the results of the LbDt-1 debitage analysis that build on the ideas presented in the earliest chapters.

The focus of Chapter 2 is to provide the necessary environmental, palaeo-climatic, and archaeological background information to frame discussions about the specific sites included in this study, and how the local environment and resource availability affected Palaeo-Inuit people's decisions around the organization of their technology and scheduling of lithic activities presented in the following chapters.

Chapter 3 discusses the culture history of the eastern Arctic, providing detailed information on the Pre-Dorset and Dorset cultures who occupied southern Baffin Island; this information is specifically focused on land use and subsistence patterns. The chapter concludes with a discussion on how interpretations of these two cultures have changed in recent years.

In Chapter 4, the theoretical approaches (i.e., organization of technology and agency) used to interpret the results of the LbDt-1 debitage analysis and its comparison with Mosquito Ridge, Sandy Point, Tungatsivvik, and Shaymark are outlined along with a discussion of several other important concepts that facilitate interpretation of the results presented in later chapters. Chapter 4 is concluded with a statement of research hypotheses.

Chapter 5 begins with a definition of debitage as an artifact category. This is followed with a description of the two methods used in the LbDt-1 debitage analysis: individual attribute and aggregate analysis. Following this is a description of the attributes selected for analysis to evaluate the hypotheses presented at the end of Chapter 4. Chapter 5 concludes with descriptions of the statistical procedures that were used to interpret the results of the debitage analysis.

The results of the LbDt-1 debitage analysis are discussed in Chapter 6. These results are organized by attribute category as defined in Chapter 5 (i.e., raw material, technological, post-depositional) and interpretations are presented in the concluding section for each of the attribute categories. This is followed by a discussion of the evidence for novice flintknapping activities at LbDt-1 and a comparison of debitage patterns between spatially discrete portions of the site. The chapter concludes with a brief interpretation of technological and novice activities represented at LbDt-1.

Chapter 7 begins with a description of previously established patterns of technological organization and lithic apprenticeship that have been described for southern Baffin Island. Following this are brief descriptions of the assemblage data for the comparative sites previously analysed by Milne (2003a). Next is a comparison of the results presented in Chapter 6 to Milne’s (2003a) data from her earlier analysis of Mosquito Ridge, Sandy Point, Tungatsivvik, and Shaymark. This comparison served to situate LbDt-1 within the regional lithic reduction sequence. Interpretations are then presented, discussing where on the landscape novices were participating in flintknapping activities.

The final chapter summarizes the findings of this study, provides interpretations of the debitage patterns identified at LbDt-1, suggests implications of this study to Arctic archaeology, and concludes with suggestions for future research in the eastern Arctic.

2. Study Area and Archaeological Background

This chapter provides the background information to facilitate a discussion of Palaeo-Inuit land use patterns on southern Baffin Island in terms of the local environment, and subsistence and lithic resource availability. These factors contribute to understanding which lithic procurement strategies were selected for by Palaeo-Inuit people in different regions of southern Baffin Island and at various points in their seasonal round. The chapter begins with a description of the geological and environmental landscape characterizing the study area, which includes the interior and southeast coastal (Frobisher Bay) regions of southern Baffin Island (Figure 2.1). Included in this discussion is a description of the local palaeo-climate and the distribution of subsistence and lithic resources available in each of these regions. This is followed by a brief overview of the contributions of past archaeological research on Palaeo-Inuit sites conducted on southern Baffin Island. The concluding section provides brief descriptions of LbDt-1 and the comparative sites discussed in this study: Mosquito Ridge (MaDv-11), Sandy Point (LlDv-10), Shaymark (KkDn-2), and Tungatsivvik (KkDo-3).

Figure 2.1 Location of study area on southern Baffin Island, Nunavut.

2.1 Environmental Background

Two regions of southern Baffin Island are included in this study: the interior region, and the southeast coastal region including the head of Frobisher Bay. The distinct characteristics of these regions drew people to each of them in the past for different purposes at specific points in their seasonal rounds.

The interior of southern Baffin Island is characterized by a system of large lakes (Nettilling, Amadjuak, and Mingo) that are interconnected by complex riverine systems. These lakes drain into one another from south to north, with Mingo Lake draining into Amadjuak Lake along the Mingo River, and the waters of Amadjuak Lake draining into Nettilling Lake through the Amadjuak River. Nettilling Lake is drained by the Koukdjuak River into the Foxe Basin to the west (Milne 2003a:15). The region around these lakes is approximately 2˚C warmer in the warm season than adjacent areas owing to the accumulation of solar-warmed river waters draining into the lakes, which raises the local air temperature (Jacobs and Grondin 1988:218). These warmer temperatures support the establishment of denser vegetation, including a variety of edible plants, which encourages animals to frequent the area (Jacobs and Grondin 1988:212). Terrain in the region is generally low-lying and flat, punctuated by glacial moraines and eskers (Milne et al. 2012:274). To the west and southwest of these lakes lies the Great Plain of the Koukdjuak—a vast, flat, marshy, poorly drained area containing numerous shallow lakes and ponds that extends south from the west edge of Nettilling Lake to the area northwest of Mingo Lake (Milne and Donnelly 2004:93; Stenton 1991a:20).

Frobisher Bay is bounded on the west by the Meta Incognita Peninsula and on the east by the Hall Peninsula. The local geography of these peninsulas comprises low hills of Precambrian rocks intersected by numerous streams draining into Frobisher Bay (Jacobs and Stenton 1985:60). Like the large lakes region in the interior, the head of Frobisher Bay is warmer than its surrounding areas during the summer (Jacobs and Stenton 1985:60). This results in lusher vegetation at the head of Frobisher Bay compared to its adjacent areas, which becomes increasingly sparse to the north (Jacobs and Stenton 1985:60). The head of the Bay cools in the winter, but winter temperatures in the Bay's outer regions are the warmest on Baffin Island (Jacobs and Stenton 1985:60). Many islands and fjords are present in Frobisher Bay, and the depth descends 200 metres within only five kilometres of its head (Jacobs and Stenton 1985:60). Frobisher Bay experiences some of the highest tides in the world, at times rising up to 14 metres

(Maxwell 1985:17). The southwestern side of the Bay is rugged with deeply incised fjords. The interplay of this steep, fjorded shoreline with the impressive tides creates optimal conditions for inshore sea mammal hunting (Maxwell 1985:9; McGhee 2001:99).

2.1.1 Southern Baffin Island Palaeo-Climate

Archaeologists working in the eastern Arctic have a long history of interest in the region's past climate (e.g., Bhiry et al. 2016; Dekin 1972; Dyke et al. 1999; Friesen 2010). The Arctic is often viewed as a harsh environment where slight changes in temperature or sea ice conditions could be disastrous for large populations of people (McGhee 2001:65–66, 107). However, this view is at odds with archaeological evidence that demonstrates that people successfully adapted to the Arctic climate and lived comfortably in the region for thousands of years.

It is common practice to look to climatic fluctuations when explaining changes in human behaviour, and Arctic archaeologists frequently link climate change with cultural developments (e.g., Dekin 1972; Fitzhugh 1997). In the eastern Arctic it seems straightforward to make these connections, as major cultural developments in the region appear to coincide with dramatic climatic changes. However, more recent works stress that the causes of culture change are much more complex than people simply reacting to changes in their environment (Brumfiel 2000:251; Dobres and Hoffman 1994), and recent palaeo-climate studies have found that these climatic fluctuations may not have been as dramatic as was once thought (Finkelstein 2016:665).

Today summer temperatures in the eastern Arctic range from 0-10˚C, while winter temperatures regularly drop to -40˚C (Maxwell 1985:19; McGhee 2001:58). When the Pre-Dorset entered this region at the end of the Post-Glacial Warm Period (4500 B.P.), temperatures were slightly higher than the twentieth century average temperature (McGhee 2001:110). The development of Dorset culture around 2700 B.P. coincides with a cooling period where temperatures were much colder than present. These cooler temperatures resulted in winters that were longer, with sea ice that was thicker and lasted for longer than in the earlier Pre-Dorset period (Jacobs and Stenton 1985:64; Maxwell 1985:122–125; Milne and Park 2016:694). This cooling trend also had more permanent affects on the local environment, resulting in the onset of permafrost and an advance of the Barnes Ice Cap in central Baffin Island (Maxwell 1985:34).

The onset of the Mediaeval Warm Period has been linked to the decline of the Dorset culture and has been cited as a factor initiating the migration of Thule from Alaska into the eastern Arctic between A.D. 1000-800 (Maxwell 1985:239; Dekin 1972:19). This global warming phenomenon was thought to have lasted from A.D. 500-1000, resulting in reduced sea ice and temperatures that were once again warmer than the twentieth century average (Maxwell 1985:35; McGhee 2001:196–197). However, more recent investigations of the eastern Arctic palaeo-climate have found that the impacts of the Mediaeval Warm Period were not nearly as significant or far-reaching as was once thought. The warming period was in fact shorter (A.D. 950-1100) and milder, and appears to have been limited to certain regions of the eastern Arctic. Thus it does not appear to have had substantial impacts on Arctic temperatures or resources (Finkelstein 2016:663–665). The interpretation that the Mediaeval Warm Period was a motivating factor for the Thule to leave Alaska is further contested by recent re-dating of early Thule sites. For example, the Nelson River (OhRh-1) and Washout (NjVi-2) sites indicate that the timing of this climatic change does not correspond as closely with the arrival of the Thule in the eastern Arctic as was initially thought. This new evidence suggests that the Thule did not enter the eastern Arctic until approximately A.D. 1200 (Friesen and Arnold 2008).

Shortly after the warm peak at the end of the Mediaeval Warm Period, temperatures cycled toward another cooling trend with the start of the Little Ice Age beginning around A.D. 1450 and lasting until A.D. 1850 (Finkelstein 2016:663; Maxwell 1985:35). Unlike the Mediaeval Warm Period, there is ample evidence that the Little Ice Age brought with it significant changes. This period is characterized by colder temperatures affecting the eastern Arctic more broadly, and resulted in advancing glaciers and expanded sea ice in the Baffin region after A.D. 1400 (Finkelstein 2016:665).

Palaeo-climate studies focused more specifically on southern Baffin Island include Jacobs et al.'s (1997) investigations, which used pollen stratigraphy extracted from sediment cores collected from Burwash Bay at the south end of Nettilling Lake. The dwarf birch (*Betula glandulosa*) pollen preserved in these cores indicated that the warm summer conditions of the interior large lakes region have been relatively stable for the past 4000 years, suggesting the subsistence resources of the interior large lakes region were predictable and reliable throughout the entire Palaeo-Inuit occupation of southern Baffin Island to present day (Jacobs et al. 1997).

Henshaw's (2003) GIS based investigations of the effects of climate change on a polynya in outer Frobisher Bay incorporated ice core data from the Penny Ice Cap near Cumberland Sound, dendrochronology, seal tooth sections, and faunal analyses of 42 Thule and historic Inuit sites. She found that the recurring polynya located in outer Frobisher Bay remained open during the cold winters of the Little Ice Age. She argued this polynya was a reliable location for sea mammal hunting during the Thule and historic Inuit periods and may have played a role in attracting people to the region (Henshaw 2003:11). Based on her findings, it is probable that this polynya persisted throughout the cold winters of the early Dorset period and was likely also an important hunting area for Palaeo-Inuit peoples. This is further supported by Finkelstein

(2016:665), who notes that the Little Ice Age was the coldest period of the Holocene. This indicates that temperatures were warmer during the Dorset period, which would result in the polynya remaining open.

2.2 Southern Baffin Island Subsistence Resources

Subsistence resources are abundant in both the interior and coastal regions of southern Baffin Island. In addition to the many edible plants available in the warm season, which contribute vitamin C and carbohydrates to the Arctic diet, abundant animal resources are available year-round on the coast and in the interior.

The resources available in the interior would have been harvested nearly exclusively in the warm season when Palaeo-Inuit people would undertake long-distance journeys inland to procure chert, hunt caribou, and visit with friends and family who lived in distant camps during the winter (Milne et al. 2013). Caribou were the primary terrestrial resource, prized not only for meat but also for their hides, which were essential for producing winter clothing and tents (Oakes et al. 1995; Stenton 1991b, 1991a:19–20). Large herds of caribou can reliably be found congregating in the interior region near Nettilling and Amadjuak Lakes early in the warm season as they migrate seasonally from the coast to an important summer feeding ground to the north of Nettilling Lake (Jacobs et al. 1997:169). Although caribou was a very important interior resource, many other interior species contributed to the Palaeo-Inuit diet. The lakes and rivers in the interior region support several species of fish, the most important to the human diet being Arctic char (Milne and Donnelly 2004:94; Stenton 1991c:7). The presence of ancient fish weirs in many of the rivers attest to the importance of this resource for Palaeo-Inuit (McGhee 2001:211). Located to the west of the large lakes, the Great Plain of the Koukdjuak is a nesting area for migrating snow geese during the warm season (Milne and Donnelly 2004:93). These birds are abundant and easily hunted during their moulting season between July and August (Milne and Donnelly 2004:94–95). The eggs from these and other migratory birds were also collected during the spring and early summer, providing another easily obtained component of the diet (Milne and Donnelly 2004:102). Nettilling Lake also supports a small year-round population of fresh water ringed seals and its name is derived from the Inuktitut word for these animals – *Netsik* (Milne and Donnelly 2004:93–94; Stenton 1991a:21). These animals could be hunted with harpoons thrown or thrusted from kayak-like vessels, or they could be hunted at breathing holes if a family chose to overwinter in the interior as has been recorded ethnographically (Boas [1888] 2013). The combination of these predictable resources and warmer summer temperatures made the interior an attractive destination for both animals and people (ten Bruggencate et al. 2016:686).

The south coast region, which includes Frobisher Bay, is rich in subsistence resources that have been pursued from Pre-Dorset times to the present, and are adequately abundant to support year-round settlements (Jacobs and Stenton 1985:62; Milne 2008:193). Both marine and terrestrial resources can be harvested in the Frobisher Bay region. Marine mammals including ringed and bearded seal can be harvested throughout the year in the Bay, and harp seal migrate into the area early in August (Henshaw 2003:2; Milne 2003a:21). Walrus and beluga can also be found during the winter in the recurring polynya in outer Frobisher Bay (Henshaw 2003:2). These species were hunted at the floe edge using thrown or thrusted harpoons (McGhee 2001:98–99). The rivers that terminate in Frobisher Bay provide Arctic char in the early summer and during the fall and continue to be popular fishing spots today (Milne 2003a:23, 35). Caribou are present on the peninsulas that border Frobisher Bay throughout the year, although part of the larger herd migrates seasonally between the head of the Bay and Nettilling Lake (Jacobs and Stenton 1985:62; Maxwell 1985:82; Milne et al. 2012:275; Milne and Donnelly 2004:94).

2.3 Lithic Raw Material Availability

Useable toolstone may be the most important resource for stone tool-using populations (Andrefsky 2005:41). Stone tools were used in nearly every aspect of daily life and had to be maintained, repaired, or replaced regularly (Hayden 1989:12). As such, the relative abundance or scarcity of this resource influenced the decisions a group made about their technology, and may have limited the size, form, and style of their lithic tools (Andrefsky 1994:23; Hayden 1989:10; Maxwell 1973:11; Nelson 1991:76–77; Wenzel and Shelley 2001:108). In both the interior and the coastal regions of southern Baffin Island, chert can only be acquired in the warm season, when snow and ice-free conditions allowed for the collection of this material during low tide on the coast or from the limestone outcrops of the interior.

In the interior region of southern Baffin Island chert is relatively abundant. This toolstone can be found in primary and secondary deposits in the Great Plain of the Koukdjuak. The local geology of the southern portion of this plain comprises fossiliferous limestone (ten Bruggencate et al. 2015:190; Stenton 1991a:20). Chert formed as a precipitate within these limestone formations and can be found eroding out of the limestone bedrock or as weathered nodules remaining with the weathering and breakdown of the softer limestone deposit (Andrefsky 2005:54; Milne 2003a:26, 2013:19). Chert is also found in secondary deposits in the interior region, having been transported and redeposited through past glacial activity (ten Bruggencate et al. 2015:191; Milne 2003a:26, 2005:338).

Unlike the interior, the southern coast of Baffin Island is devoid of chert-bearing sedimentary outcrops, which creates scarcity in available toolstone in the region (Maxwell 1973:10). The limited chert that is available on the coast is found on the ocean floor and can only be accessed during low tide in the warm season (Maxwell 1973:11; Milne 2008:185). This coastal chert only occurs as small, weathered pebbles (Maxwell 1973:11; Milne 2008:185), and its small size and poor quality significantly restricted the kinds of tools that could be produced from it in these coastal areas. This limitation is responsible for some of the regional variation observed between Palaeo-Inuit artifacts from southern Baffin Island and other areas of the eastern Arctic (Friesen 2016a:675; Maxwell 1973:11; Milne 2008:185; Milne et al. 2013:57; Wenzel and Shelley 2001).

2.4 Southern Baffin Island Contributions to Palaeo-Inuit Archaeology

Much of our understanding of Palaeo-Inuit cultures and past lifeways in the Eastern Arctic stems from research conducted on southern Baffin Island. Early studies conducted by Jenness (1925) and Collins (1950) made significant contributions to our overall understanding of Palaeo-Inuit archaeology. Specifically, Jenness' (1925) investigation of artifacts recovered from Cape Dorset led to the identification of Dorset culture (Jenness 1925:435), while Collins' (1950) work at the multi-component Crystal II (KkDn-1) site, located on the east bank of the Sylvia Grinnell River near Iqaluit, was the first to identify stratigraphic evidence proving that Dorset was an older culture than the Thule. Maxwell's later (1973:286, 1976) investigations of the complex of sites at Lake Harbour is also significant because it demonstrated cultural continuity and continuous occupation over 2500 years from the early Pre-Dorset through to the Late Dorset period (Maxwell 1973:286, 1976).

Early archaeological investigations on Baffin Island focused predominantly on coastal regions (e.g., Collins 1950; Maxwell 1973). Stenton's surveys in the 1980s along the banks of Mingo, Amadjuak, and Nettilling Lakes represent the first intensive survey of the adjacent interior region (Stenton 1991a, 1991b, 1991c). His fieldwork was aimed at locating Thule summer camps, but in the process Stenton also identified numerous Palaeo-Inuit sites (Stenton 1991c) demonstrating that the interior is far richer in Palaeo-Inuit archaeological sites than was previously known. In more recent years, archaeological investigations have improved our understanding of Palaeo-Inuit use of these regions of southern Baffin Island. These studies have provided important insights into Palaeo-Inuit subsistence practices, lithic procurement strategies, and social structures, and have challenged the accepted notions that the Dorset remained on the coast year-round and did not travel to the interior regions (e.g., Landry 2013; McAvoy 2014; Milne 1999, 2003a; Milne et al. 2012, 2013; Milne and Donnelly 2004).

2.4.1 Archaeological Investigations of Chert Sources on Southern Baffin Island

Amadjuak Lake has long been considered an important location for chert procurement as indicated by its name, which is derived from the Inuktitut word – *ammaq* or *angmalik* that roughly translates to "the place chert comes from" (Milne 2003a:26, 2005:338; Stenton and Park 1998:25). Informed by this traditional knowledge, archaeological surveys were conducted in 2013, 2014, 2015, and 2018 in the interior region with the goal of locating and investigating chert sources. These surveys resulted in the identification of three chert quarries known as LbDt-1, LbDt-2 (provisionally), and LdDx-2 (ten Bruggencate et al. 2015:191; Milne 2013, 2019). These three sites are currently the only chert quarries known on southern Baffin Island.

LdDx-2 or "Chert Island" is located on a small peninsula on the southwest shore of Amadjuak Lake (Figure 2.2) (ten Bruggencate et al. 2015:191). This area is thought to have been an island in the past, but is now connected to the lake shore due to either isostatic rebound or receding water levels (Milne 2013:19). Chert is eroding out of the limestone bedrock at the site and can be easily collected by hand from surficial gravels (ten Bruggencate et al. 2015:192; Milne 2013:19). In addition to the vast quantities of raw chert located at LdDx-2, several features including tent rings were identified in nine areas with associated debitage scatters. A few burin spalls were collected from the lithic scatters indicting that the site was used by Pre-Dorset people (ten Bruggencate et al. 2015:192; Milne 2013:22).

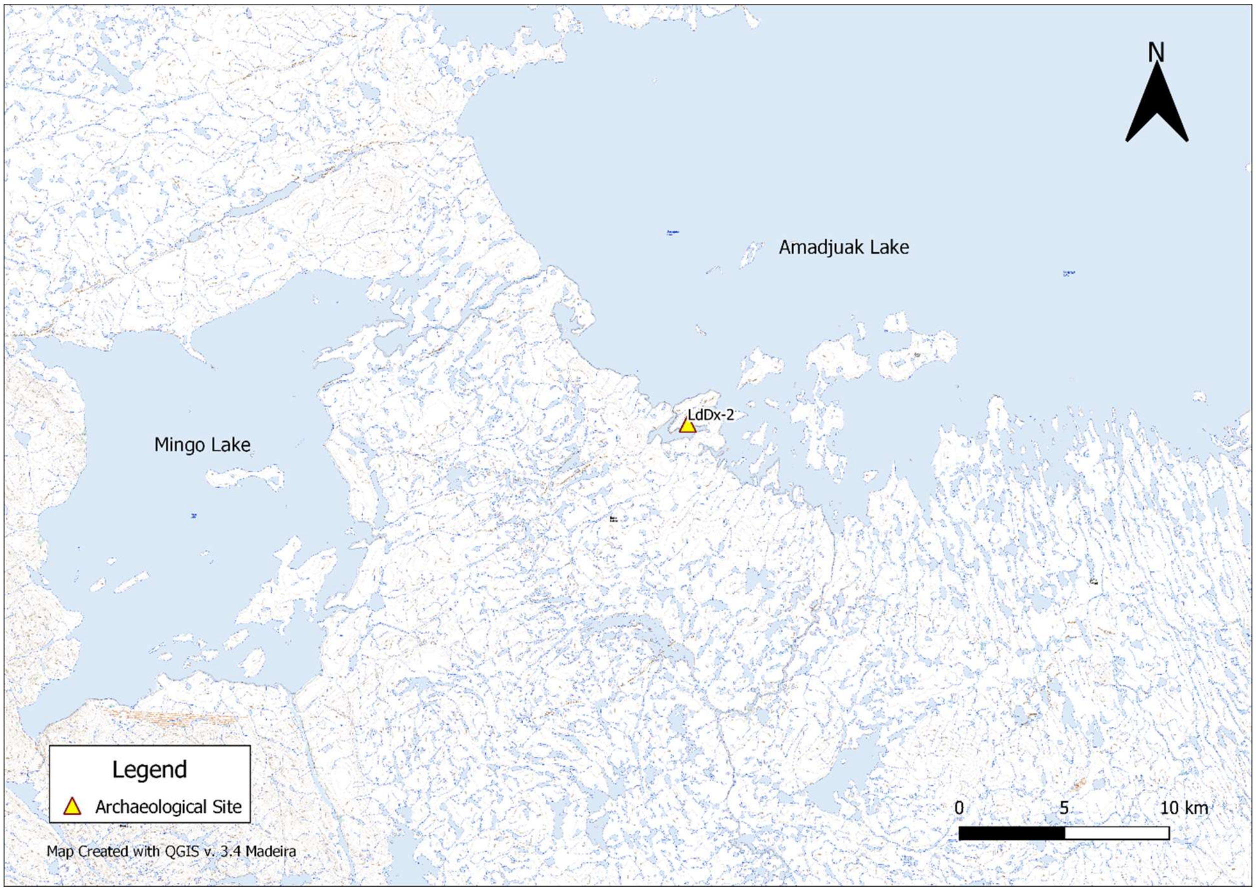


Figure 2.2. Location of chert quarry LdDx-2.

Located approximately 70 kilometers south-southeast of LdDx-2, LbDt-2 is situated on the west bank of the Hone River, directly across from LbDt-1 (Figure 2.3) (Milne 2019:5).

Unworked chert nodules were identified eroding out of limestone boulders on the steep scree slope that descends into the river. Lithic debitage was identified both on the sandy banks of the river at water level and on the flat valley margin overlooking the river (Milne 2019:5). Unlike the other two quarries, no tent rings or other features were identified in the vicinity of the chert deposit, and no diagnostic artifacts were found on the surface (Milne 2019:5). LbDt-1 is the focus of this thesis and is described below in section 2.5.1.

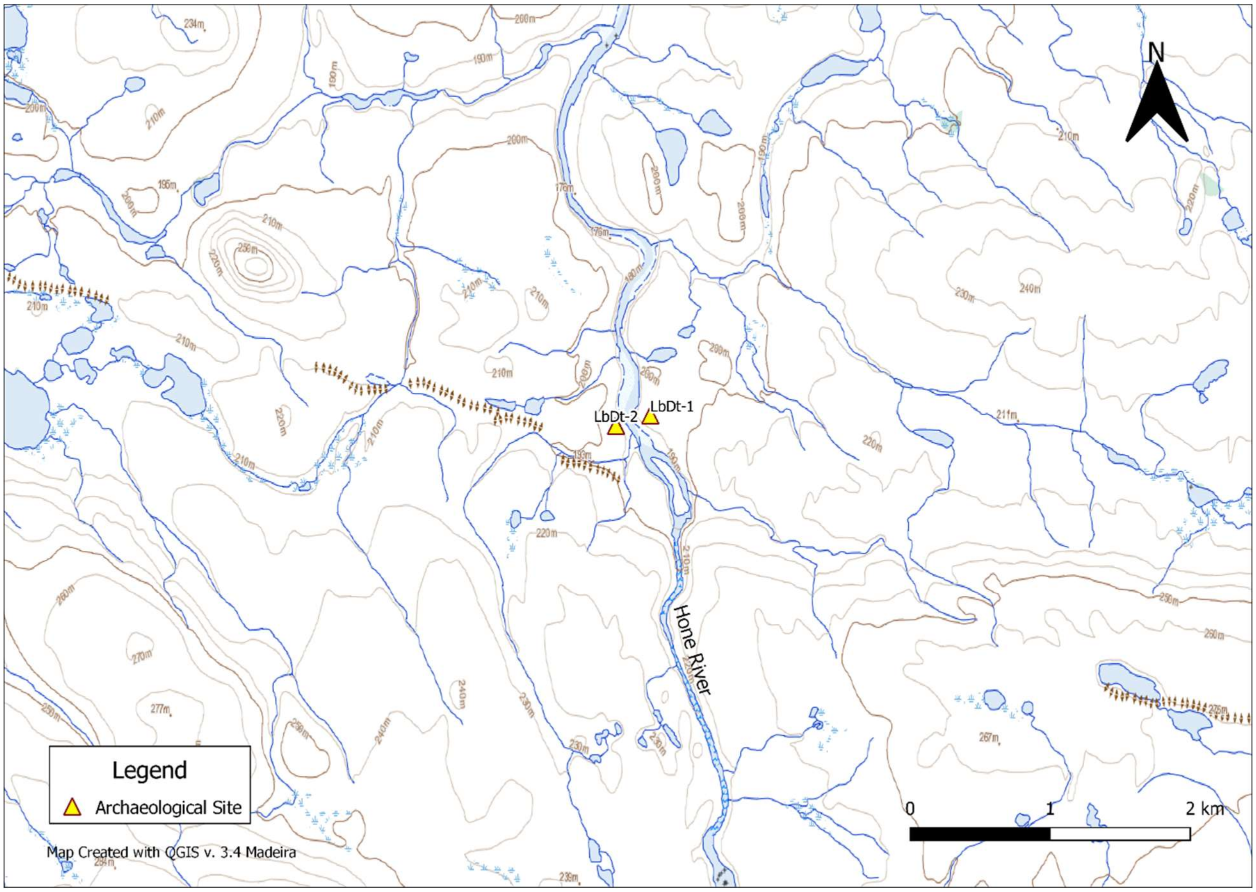


Figure 2.3. Locations of quarry sites LbDt-1 and LbDt-2.

The identification of these chert quarries provided the opportunity to pursue research focused on chert sourcing, which can directly link quarry sites to habitation or other use sites across southern Baffin Island. Chert from two interior quarry sites (LbDt-1 and LdDx-2) has been geochemically characterized and compared to determine if these chert sources could be differentiated from one another (ten Bruggencate et al. 2015). While there was some overlap, the chemical signatures of these chert sources are sufficiently distinct to isolate material originating from each location (ten Bruggencate et al. 2015:193). These results prompted researchers to apply the same geochemical characterization to artifacts found at coastal sites, including Crystal II (KkDn-1) and Tungatsivvik (KkDo-3) located at the head of Frobisher Bay, and to sites in the interior (LeDx-42, LdFa-12, LdFa-13, and LdFa-14), as well as with Seahorse Gully (IeKn-6), a Pre-Dorset site located in northern Manitoba (ten Bruggencate et al. 2017).

Comparison of the geochemical signatures of chert debitage acquired from these sites to those from the two chert quarries found that while many fell within the overlapping zone of the two quarries, some materials could be sourced with confidence (ten Bruggencate et al. 2017:659). Tungatsivvik (KkDo-3) and LdFa-12 each produced one artifact that was deemed to have originated at LbDt-1. Artifacts collected from LdFa-12, LdFa-13, LeDx-42, Tungatsivvik (KkDo-3), and Crystal II (KkDn-1) were consistent with chert from LdDx-2 (ten Bruggencate et al. 2017:659). These results demonstrate that chert was transported from the interior quarries to sites located in the interior, and also link the interior quarries to coastal sites. Three artifacts from Tungatsivvik (KkDo-3) did not match either quarry, indicating that Palaeo-Inuit utilized other still unidentified chert sources on Baffin island (ten Bruggencate et al. 2017:659).

2.5 Sites Included in this Study

The focus of this research is the lithic debitage from the quarry site LbDt-1. The assemblage data from LbDt-1 are compared to Milne’s (2003a) analyses of Mosquito Ridge (MaDv-11), and Sandy Point (LlDv-10) located on the west bank of Burwash Bay at the south end of Nettilling Lake, and to Tungatsivvik (KkDo-3), and Shaymark (KkDn-2) located at the head of Frobisher Bay (Figure 2.4). This comparison allowed me to situate LbDt-1 within the regional lithic reduction sequence and to isolate debitage patterns unique to the quarry. The following section provides a brief description of each of these sites.

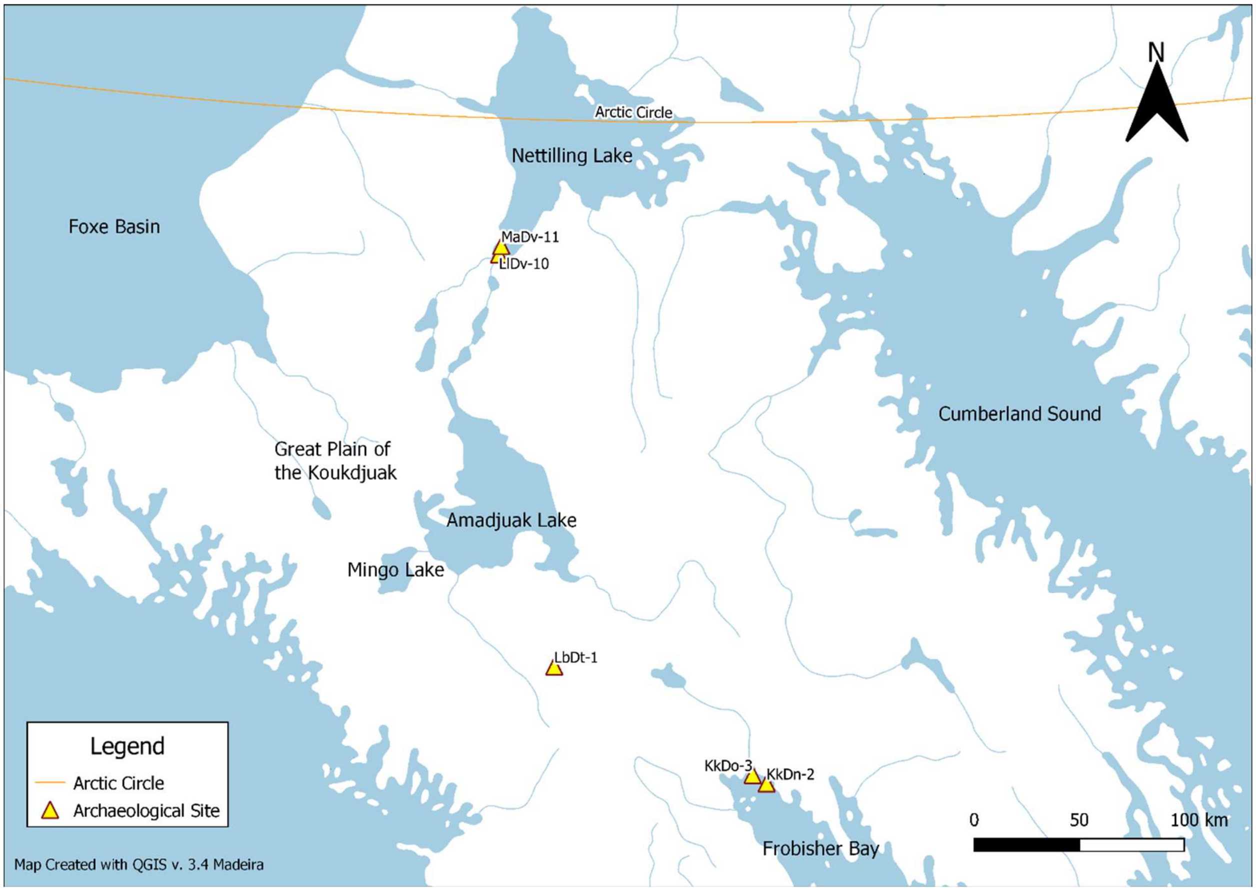


Figure 2.4. Location of LbDt-1 and comparative sites.

2.5.1 The Interior Sites

LbDt-1

LbDt-1 is a chert quarry located on the east bank of the Hone River, approximately 42 kilometers south of Amadjuak Lake and 155 kilometers west-northwest of the city of Iqaluit (ten Bruggencate et al. 2017:652; Landry et al. 2019). The site is very large, with chert debitage covering approximately five to six acres spread over an upper and a lower component (Milne

2013:26). The distinction between the upper and lower components was created to facilitate discussion of the site and does not refer to a difference in occupation histories. The upper component refers to the flat terrace overlooking the river, while the lower component describes the beach at water level (Landry et al. 2019).

The lower component of the site is being actively eroded through undercutting by the river and a significant portion of the site may have already been lost (Landry et al. 2019; Milne 2013:25). Limestone bedrock exposures are prominent features of the lower component and abundant chert nodules can be easily extracted from this outcrop as they are eroded from the limestone bedrock through weathering and annual freeze-thaw cycles (ten Bruggencate et al. 2017:652; Landry et al. 2020:159; Milne 2013:28). The thick vegetation on this lower component makes it difficult to determine if any tent rings are present (Landry et al. 2019).

The upper component has a “carpet” of debitage spanning over an acre. Approximately 300 meters east of the debitage scatter are five well-defined, heavily-constructed tent rings along with numerous associated features that may be hearths or windbreaks (Landry et al. 2019; Milne 2013:26). Investigative test pits were excavated on both components of the site in 2013 and 2015 to determine its cultural affiliation (Landry et al. 2019). These excavations yielded thousands of pieces of debitage but no diagnostic artifacts were recovered. Only six possible burin spalls were identified from the upper component indicating that Pre-Dorset people used this site. Despite lacking diagnostic artifacts, it is likely that LbDt-1 was used by both Pre-Dorset and Dorset people based on the extensive deposit of chert debitage (Landry et al. 2019).

MaDv-11: Mosquito Ridge

Mosquito Ridge is located on the west bank of Burwash Bay, at the south end of Nettilling Lake (Figure 2.4). It sits on top of a large gravel esker which branches off of the West Burwash Moraine (Milne 2003a:40, 2005:333). The site is large and comprises many components with over 30 features representing Palaeo-Inuit, Thule, and Inuit occupations (Milne 2003a:41, 2005:333). The continued use of this site from the first Arctic occupants into the historic period points to its significance as a meeting place, owing to its central location in the interior and the local abundance of lithic and subsistence resources (Milne 2003a:254, 2008:191). Lithic artifacts and diagnostic Palaeo-Inuit debitage are found spread across the entire site area (Milne 2005:333). Initial investigations found the western portion of the site to be an undisturbed Pre-Dorset component consisting of two possible tent rings and five lithic scatters (Milne 2003a:41). In 2000, Milne thoroughly surface collected this area and completed excavations on three grids. These excavations recovered a large faunal assemblage demonstrating that the site was unusually well preserved for the Pre-Dorset period, but the excavation did not discover definitive structural features (Milne 2003a:42). Investigations during 2003 yielded a radio-carbon date from caribou bone placing the Pre-Dorset occupation around 3800 ± 40 B.P., making Mosquito Ridge one of the earliest dated sites in the eastern Arctic (Milne and Donnelly 2004:96). The Mosquito Ridge faunal assemblage is dominated by migratory bird species (specifically snow goose), indicating a late spring or summer occupation (Milne 2003a:251–252; Milne and Donnelly 2004:107–108). The massive debitage assemblage collected from Mosquito Ridge indicates that the site was regularly reoccupied by Pre-Dorset people who transported partially-reduced chert to the site for stone tool manufacture, focusing primarily on core reduction and preform production (Milne 2003a:247). The people occupying this location could rely on easily hunted snow geese for subsistence, allowing them to concentrate more time and effort on tool production, while enjoying a relaxed atmosphere that encouraged socialization with members of other groups who also travelled to Mosquito Ridge to re-supply their toolkits (Milne 2003a:254; Milne and Donnelly 2004:107).

LlDv-10: Sandy Point

Sandy Point is located 10 kilometers south of Mosquito Ridge on the western shore of Burwash Bay. It is a small Pre-Dorset site that was surface collected and excavated to mitigate the effects of erosion (Milne 1999:9, 2005:331, 2009:43). The site dates to at least 2815 ± 65 B.P. and is split into three areas: mainland, channel, and island. The small island was originally a peninsula, but has since separated from the mainland through the process of erosion that continues to wear down the island's northern and southern coasts (Milne 1999:12, 2005:331, 2009:43). At the north end of the island sits a small tent ring with a possible internal hearth feature. This tent ring is not thought to be contemporaneous with the Pre-Dorset occupation, as no artifacts were found associated with it and it rests above the Pre-Dorset strata (Milne 1999:12, 14, 2003a:40, 2009:43). The channel separates the island from the mainland. Two bifaces were identified underwater in this portion of the site, resulting in its inclusion within the site extent (Milne 2009:43). The mainland portion of the site lacks any features but has a substantial lithic scatter (Milne 1999:10, 2005:331). This site has been interpreted as a location where small task-groups spent short periods during the warm season engaged in lithic raw material testing and the production of lithic tool preforms and blanks from local chert sources (Milne 2003a:229, 232–233).

2.5.2 The Coastal Sites

KkDn-2: Shaymark

Shaymark is a single-component Pre-Dorset site dating to 3675 ± 144 B.P. (Milne 2003a:34). It is located at the head of Frobisher Bay on an old beach ridge to the east of the Sylvia Grinnell River, and to the west of Iqaluit. The eastern portion of the site is a popular spot for picnicking and fishing for Arctic char, and has been severely disturbed due to its use as a car turn-around. As a result, artifacts can be readily collected from tire ruts (Maxwell 1973:277; Milne 2003a:35). The south end of the site is undisturbed and comprises a single tent ring with many lithic artifacts visible inside and around the feature (Maxwell 1973:277).

Shaymark was first identified by Maxwell in the 1960s and since that time the site has been frequently revisited by archaeologists (see Milne 2003:35 for examples). In 1999, 285 square meters were informally excavated and areas adjacent to the excavations were surface collected by archaeologists, community members, and Arctic College students to mitigate damages caused by the continual use of the site (Milne 2003a:35). This mitigative project led to the identification of an intact component (Shaymark East), which significantly extended the site's dimensions (Milne 2003a:35). A diverse lithic tool assemblage and large debitage collection was recovered from Shaymark leading to an interpretation that the site was regularly reoccupied during the late summer by the whole Pre-Dorset social group (Milne 2003a:161). Subsistence resources within the vicinity of the site in the late summer are varied and reliable, which allowed the occupants to focus their energy on organic tool production and sewing activities (Milne 2003a:163–164).

KkDo-3: Tungatsivvik

Located approximately 10 kilometers west of Shaymark and Iqaluit, Tungatsivvik is situated on the north shore of Peterhead Inlet at the head of Frobisher Bay (Milne 2003a:37; Stenton and Rigby 1995:49). This large, multi-component site consists of at least 100 features representing warm season and winter occupations of Pre-Dorset, Dorset, Thule, and Inuit groups (Milne 2003a:37; Stenton and Rigby 1995:49). These features include warm and cold season dwellings, caches, kayak stands, and burials (Stenton and Rigby 1995:49). In 1999, an isolated Pre-Dorset component (Area D) located near a cluster of Thule houses at the centre of the site was excavated resulting in a small assemblage of lithic artifacts (Milne 2003a:38). This area is interpreted as an ephemeral Pre-Dorset warm season camp where activities were focused on stone tool maintenance and included some tool production using locally available chert in preparation for the long journey to the interior (Milne 2003a:216).

Also in 1999, investigative test pitting in an undisturbed area to the east of the main site (Area Q) resulted in the identification of the only undisturbed single component Pre-Dorset area at Tungatsivvik. Excavations were expanded into this area revealing a buried elliptical tent ring (Milne 2003a:37–38). While faunal remains are sparse for this locus, lithic evidence suggests that it was occupied during the warm season (Milne 2003a:198). The presence of a tent ring, the relatively large lithic assemblage, and the use of local chert support the interpretation that this location was occupied by members of the Pre-Dorset social group who remained in the coastal uplands during the warm season, while the rest of the group travelled to the interior (Milne 2003a:199–201).

2.6 Conclusion

Mosquito Ridge, Sandy Point, Shaymark, and Tungatsivvik have been selected for comparison with LbDt-1 because they represent opposite ends of the Palaeo-Inuit continuum of mobility patterns between coastal and inland areas. Comparing these sites to each other and to LbDt-1 provides an opportunity to consider how the sites are connected across this vast landscape, and how they each relate to chert procurement strategies and novice flintknapping activities on southern Baffin Island.

3. Pre-Dorset and Dorset Cultures

This chapter presents an overview of the current published interpretations of Pre-Dorset and Dorset (c. 4500-500 B.P.) land use, settlement and subsistence strategies on southern Baffin Island. It also details more recent views of these people's lifeways (Landry 2013; Milne 2003a; Milne et al. 2013), which have expanded our understanding of these cultures in this region of the Arctic.

3.1 Early Migrations into the Eastern Arctic

The history of the eastern Arctic is often explained through successive migrations of people from the Bering Strait region of Alaska. The earliest migration was undertaken by a population collectively known as the Arctic Small Tool Tradition (ASTt), reflecting the consistently small stone tools found at early sites across the Arctic region (McGhee 2001:37). This group arrived in the eastern Arctic at approximately 4500 B.P. (Milne and Park 2016:695). The catalyst for this eastward migration is unknown; however, some researchers argue that population pressure in Alaska was the main motivation (Maxwell 1985:47). Others have proposed that these people began following herds of musk-ox eastward when these animals, along with caribou, were experiencing population booms at the end of the thermal maximum (McGhee 2001:110). As the herds were depleted, people moved further east into new terrain to find new herds that could be exploited. Upon reaching the Canadian Arctic Archipelago, these ASTt people diverged into three archaeological populations. The group who came to be known as Independence I, is believed to have travelled north along the "musk-ox way" through the High Arctic into northeastern Greenland (Grønnow 2016:714; McGhee 1996:31). The other groups are thought to have followed the "caribou way" traversing the Low Arctic (Grønnow 2016:714). The Saqqaq settled in western Greenland, expanding into the High Arctic and northeastern Greenland

(Grønnow 2016:714–715). The Pre-Dorset occupied the largest region of the three archaeological populations; spanning as far north as Ellesmere Island in the High Arctic, as far east as Labrador, west to Banks Island, and as far south as the coasts of Hudson's Bay and the sub-Arctic barren grounds (Bielawski 1988:53; Milne and Park 2016:693). Over time each of these groups developed regionally distinct material culture as they adapted to their unique environments and available resources (Maxwell 1985:42).

Despite the large number of sites attributed to Pre-Dorset, it remains one of the least understood ASTt cultures (McGhee 2001:71; Milne and Park 2016). This is owing in part to the timing of their entrance into the eastern Arctic, which coincided with warmer temperatures, resulting in poorer archaeological preservation (McGhee 2001:72). The landscape of the low Arctic is also a likely factor. Few areas are suitable for camping and as such, Pre-Dorset sites were frequently reoccupied and the remains of their structures were dismantled by later Dorset, Thule, and Inuit groups (McGhee 2001:72). Challenges to understanding the Pre-Dorset reflect the development of the region's culture historical sequence, where for 15 years or so, any sites that could not be attributed to the later Dorset or Thule cultures were grouped into the "catch-all" category of pre-Dorset (Milne and Park 2016:703). Since that time, a clearer definition of Pre-Dorset culture has been developed and our understanding of this group has steadily improved (Milne and Park 2016:703).

3.2 Pre-Dorset Land Use, Settlement Patterns, and Subsistence

The Pre-Dorset practiced a dual subsistence economy, that required their year was split between the interior and the coast to take advantage of the seasonally available resources in each respective locale (Hodgetts 2007:354; McGhee 2001:92, 125; Milne et al. 2012:270, 2013:49, 2014; Milne and Park 2016:696; Murray 1999:471).

In the winter, the Pre-Dorset lived on the coast or on the sea ice where they hunted marine mammals. The Pre-Dorset relied heavily on seal for their winter subsistence but also pursued walrus, polar bear, beluga, and narwhal (Maxwell 1984:361). Winter hunting activities were focused on the fast-ice edge where animals were harvested using hand-thrusted toggling harpoons (Maxwell 1985:85). Sealing was also practiced at breathing holes and walruses were hunted at their haul-out areas (Maxwell 1985:85-87). During the winter, the Pre-Dorset lived in snow houses or in tents banked with snow. These dwellings are represented archaeologically by oval-shaped patches of vegetation lacking any peripheral markers and with little midden accumulation (Maxwell 1984:362; Milne and Park 2016:697; Murray 1999:470; Ramsden and Murray 1995:107; Ryan 2003:38-39). While extremely rare, small oval or round soapstone lamps have been recovered from Pre-Dorset sites. Maxwell (1984:362) has suggested that their use was restricted to the context of heating snow houses.

In the warm season, Pre-Dorset people travelled to the interior regions where they shifted their subsistence strategy to focus on terrestrial resources. The coast and interior regions on southern Baffin Island are separated by hundreds of kilometres and overland travel between the two environments was likely completed on foot. Archaeologists have yet to recover evidence for Palaeo-Inuit dog sled use, but there is evidence that the Pre-Dorset had intermittent access to dogs (Morey and Aaris-Sørensen 2002:50). Some have suggested that pathological vertebra indicate that dogs may have occasionally been outfitted with paniers or travois to assist with the transportation of goods (Morey and Aaris-Sørensen 2002:46, 50). When terrestrial resources were seasonally abundant, they could be harvested in large quantities using cooperative hunting methods (Milne and Park 2016:697). Inland resources harvested by the Pre-Dorset included Arctic char, caribou, musk-ox, ptarmigan, migrating waterfowl, Arctic fox, Arctic hare, and presumably a variety of edible plants (Hodgetts 2007:354; Milne and Donnelly 2004:94-95; Milne et al. 2012:271, 2013:52). Terrestrial animals were hunted with an elaborate toolkit including lances, non-toggling harpoons, bow and arrows, and occasionally with the assistance of hunting dogs who drove large herd animals into lakes where they were speared by hunters using harpoons or lances (Maxwell 1984:361, 1985:86, 88-89; Milne and Park 2016:695).

In most regions, the seasonal movements between the coast and the interior were a defining feature of Pre-Dorset lifeways. However, in resource rich regions such as those in the vicinity of Igloolik, Mittamatalik, Button Point, Back Bay, and North Bay Pre-Dorset people were able to remain in the same area nearly year-round (Maxwell 1985:82; Milne and Park 2016:696; Ramsden and Murray 1995). Despite the abundant food resources available, those living in resource-rich locales still had to practice some mobility to procure necessary resources not available in their immediate vicinity. These may include caribou skins, antler, and toolstone, and to maintain important social relationships with other communities (Milne 2003a, 2008; Milne et al. 2013).

There is considerable variation in Pre-Dorset housing structures. Most are interpreted as single-family dwellings, but there is some evidence that communal living was occasionally practiced (Ryan 2003:39). Warm season tents are recognized archaeologically by a well-defined circular or oval perimeter ring of rocks or a gravel berm and in most regions, a central hearth feature (Maxwell 1985:97). Sometimes tent ring remains are less obvious and are identified only by the presence of a central hearth or scattered stones (Maxwell 1984:362; Milne and Park 2016:697; Murray 1999:470; Ramsden and Murray 1995; Ryan 2003:38-39). Occasionally Pre-Dorset hearths were box-shaped, constructed using upright stone slabs and sometimes embedded within axial features that divided the tent in half. However, these features and interior hearths are rare on Baffin Island (Hodgetts 2007:354; Milne 2003b:80; Ryan 2003:33). When Pre-Dorset hearths are present, they are most often represented by charcoal-stained clusters of rocks in the centre of the structure (Bielawski 1988:53; Maxwell 1984:362; Milne and Park 2016:697).

From 2750-2450 B.P. Pre-Dorset culture underwent significant changes as it developed into what archaeologists refer to as the Dorset culture. This interval of cultural development is termed the "transitional period." The transitional period is recognized archaeologically through sites that possess traits of both Late Pre-Dorset and Early Dorset cultures (Damkjar 2003). For example, the Killilugak site on Baffin Island and several sites on Somerset Island demonstrate a shift in artifact type and form during Late Pre-Dorset developing towards Early Dorset forms. These changes include the appearance of larger soapstone lamps, slate knives, artifact treatments such as tip-fluting on end-blades and grinding on burins, and the increased use of a wider variety of lithic raw materials (Damkjar 2003; Maxwell 1985:109–111, 113). Climatic conditions steadily deteriorated in the transitional period; as temperatures dropped snow fall increased and the sea ice expanded (Dekin 1972:15). During this period Pre-Dorset populations declined, and some Arctic regions were abandoned (Friesen 2007:198; McGhee 2001:116). The reduced population and regional abandonments are likely attributable to the cooler climate. This change impacted the population and distribution of terrestrial herd animals making them harder to find and to hunt, and made sea ice formation unpredictable, resulting in more difficult seal hunting conditions (Damkjar 2003:228; Helmer 1991:315; McGhee 2001:125).

3.3 Dorset Land Use, Settlement Patterns, and Subsistence

The cooling trend that began in the transitional period continued into Dorset times (c. 2500-500 B.P.). This dramatic cooling lengthened the duration of winters and increased the sea ice extent. These changes improved ringed seal habitat, which, in turn, led to an increase in their population (Darwent 2004:68; Henshaw 2003:9; Jacobs and Stenton 1985:64). These conditions allowed the Dorset to thrive in coastal environments, and this change in climate is thought to be the stimulus for Dorset cultural development (Ryan 2016:764). The Dorset population rapidly increased immediately following the transitional period. This increase led to the eventual resettlement of regions abandoned by the Pre-Dorset including Greenland and the High Arctic, and the expansion into new territories, such as Newfoundland that were not reached by the Pre-Dorset (Helmer 1991:315; Maxwell 1985:80, 185; McGhee 2001:117).

The Dorset are viewed as more sedentary than the Pre-Dorset, spending most of their time on the coast (Milne et al. 2012:273; Murray 1999:472; Ryan 2016:770). This sedentism is inferred based on the Dorset's adoption of larger, more permanent architecture, increased use of storage structures, and significant midden deposits (Darwent 2004:70; Friesen 2007:200; Milne et al. 2012:271-272; Ryan 2016:770). The Dorset subsistence economy focused on harvesting a broad array of marine resources, while terrestrial species that were mainstays of Pre-Dorset subsistence declined in importance (Maxwell 1984:364; McGhee 2001:116–117; Milne et al. 2012:273; Murray 1999:472; Ryan 2016:770). By focusing their subsistence strategies on the coast (Darwent 2004:71), Dorset people could reduce the need to pursue long distance travel to the interior regions.

Like the Pre-Dorset, the Dorset continued to live in a variety of dwelling types including skin tents in the summer and snow houses in the winter (Maxwell 1980:506). During the Early Dorset, additional dwelling forms were adopted including rectangular, semi-subterranean winter houses (Appelt et al. 2016:789-790; Maxwell 1984:366; McGhee 1996:131; Odess 1998:420). Large communal houses were occupied by Middle Dorset people for short periods during the fall caribou migration; these dwellings were likely precursors to the longhouses used by Late Dorset peoples during seasonal aggregations (Friesen 2007:200, 2016b:206–207; Maxwell 1984:366). In most regions Dorset winter houses retained the axial features identified in the Pre-Dorset. However, these are very rare on Baffin Island (Maxwell 1985:155). Where they do occur, they lack central heath features indicating that they were heated using soapstone lamps (Maxwell 1985:149; McGhee 2001:131). The presence of Late Dorset houses with multiple hearth stands identified on Little Cornwallis Island have been interpreted as evidence that some Late Dorset families cohabitated year-round (LeMoine 2003:133). Dorset settlements typically consisted of one or two dwellings that housed six to seven people and were separated by several hundred kilometers indicating a very low population density (Milne 2008:179–180; Odess 1998:420).

While the Dorset primarily focused their hunting activities on a wide breadth of marine resources, they also took advantage of nearly every available food source; they hunted narwhal, beluga, polar bear, musk-ox, caribou, Arctic hare, Arctic fox, ducks, geese, ptarmigan, Arctic char and lake trout (Friesen 2007:200; Maxwell 1984:365). The Dorset were experts at hunting seal and walrus from the sea ice edge and breathing holes with harpoons (Maxwell 1985:132; McGhee 2001:117; Milne et al. 2012:273; Murray 1999; Odess 1998:420). They developed distinctive large harpoon heads not found in Pre-Dorset period deposits—these are associated with greater intensity of large seal and walrus hunting (Appelt et al. 2016:788; Maxwell 1985:135; Murray 1999:474). The Dorset likely used kayak-like vessels in the warm season for open-water hunting (Maxwell 1985:136; Odess 1998:420). However, their use may have been restricted to hunting immature seals, as Dorset harpoons are thought to be most effective when thrusted rather than thrown, and no artifacts associated with floatation devices have been identified (Appelt et al. 2016:785; Maxwell 1985:136–137). Like the Pre-Dorset, the Dorset used harpoons and lances in warm season hunts of caribou and musk-ox when herds could be corralled into lakes and speared there with the assistance of *inuksuk* drive lanes (Maxwell 1984:364, 1985:86; McGhee 2001:144; Milne et al. 2012:281). While not emphasized in the literature, fishing was likely an important subsistence activity for the Dorset, as their communities tended to be located near good fishing areas marked by the presence of weirs (Maxwell 1984:365, 1985:141).

Unlike the Pre-Dorset, there is little regional variation within Dorset material culture. Their tools and art are very uniform across their vast geographic territory and changes occur nearly simultaneously in distant regions (Cox 1978:113; Helmer 1991:315; Maxwell 1985:82; McGhee 2001:148). Dorset technology reflects the cooler climate (McGhee 2001:116; Milne and Park 2016:695). New tool types were developed including: ice creepers, snow knives, rectangular soapstone lamps, and specialized sea mammal hunting equipment (Darwent 2004:70; McGhee 2001:130; Murray 1999:474). Artifact treatments such as tip-fluting and grinding that first appeared in the transitional phase became more frequent in the Dorset period, as did the frequency of microblade use, and the practice of restricting the use of specific lithic raw materials to distinct artifact types (Maxwell 1985:197). Burins used for cutting and engraving hard organic materials changed from the Pre-Dorset spalled form into a ground and polished burin-like tool (Maxwell 1985:150). The shift to burin-like tools during the Dorset period suggests that the burin-spall tools used by the Pre-Dorset must have been replaced by another implement, or the tasks that required spall tools were no longer performed during the Dorset period (Park et al. 2017:67).

Two technologies that were widely used during the Pre-Dorset period do not appear to have been used by Dorset toolmakers. These include the bow drill, and the bow and arrow (Maxwell 1985:128). Drills were used by the Pre-Dorset to split organic materials and to perforate needles and harpoon components (McGhee 2001:142). The absence of this tool in Dorset assemblages is recognized by the presence of diagnostic gouged holes in organic artifacts (Maxwell 1985:128; McGhee 2001:142). The bow and arrow was commonly used by the Pre-Dorset to hunt terrestrial animals, but there is little evidence for its continuation into the Dorset period (Maxwell 1984:364, 1985:128; Milne et al. 2013:53). Maxwell (1985:128) and McGhee (2001) argue that the discontinued use of these implements must be related to Dorset ideological beliefs, as there is no functional reason for them to fall out of use, especially considering the similarity between Pre-Dorset and Dorset tool kits and resource bases. McGhee (1996) has suggested two possible explanations for why the Dorset abandoned these tools. His first suggestion is that Dorset people may have believed that the whirring sound produced when the bow drill is used could conjure bad weather conditions, thus to prevent bad weather, they avoided using the drill (McGhee 1996:142, 144). Alternatively, older community members may have died before they had the opportunity to teach the next generation how to use or manufacture these technologies, resulting in the loss of these tools (McGhee 2001:144–145). A modern example of this comes from the Polar Inuit, who, when encountered by early Inuit and European explorers, attributed their lack of bow and arrow technology, fish spears, and kayaks to the loss of craftsmen and adult hunters during an epidemic. When those skilled community members were lost the manufacture techniques for these technologies were also lost (McGhee 2001:144).

Despite the Dorset tendency towards “compulsive standardization,” the Dorset culture of Baffin Island and Foxe Basin does not entirely conform to the patterns defined in other regions (Maxwell 1985:127). Here, the use of spalled burins persists throughout the Dorset sequence (Maxwell 1985:150); tip fluted end blades are uncommon, possibly due to the low quality of available lithic raw material (Maxwell 1985:177); axial features in winter houses are absent or ill-defined (Maxwell 1985:155); no Late Dorset longhouses have been found (Friesen 2007); and, mobility is relatively unchanged on southern Baffin Island from the Pre-Dorset through to the Late Dorset period owing at least in part to the distribution of toolstone on southern Baffin Island (Landry 2013; Milne et al. 2013).

Like the end of the Pre-Dorset period, the terminal phase of Dorset coincides with a change in the global climate. This time, instead of a cooling trend the Dorset had to deal with a global warming phenomenon known as the Medieval Warm Period (c. A.D. 900-1200). This warming event likely resulted in the rapid melting of sea ice, which would have impacted animal migration patterns, and by extension, Dorset hunting success (Maxwell 1985:251; McGhee 2001:118). In addition to the stresses of the changing climate, the Dorset may also have had to contend with a new threat—the arrival of the Thule people migrating eastward from Alaska (Maxwell 1985:239). Maxwell (1985:240) and Park (2016) both argue that there is insufficient evidence to suggest that any contact occurred between the Dorset and Thule, and recent genetic research supports their views (Raghavan et al. 2014). Others disagree and believe that contact between these two cultures was likely a factor in the disappearance of the Dorset (Appelt et al. 2016:799; Friesen 2016a:682).

3.4 Recent Re-Evaluation of the Pre-Dorset and Dorset Cultures

Past research in the eastern Arctic has largely focused on defining the regional culture history with a strong environmental deterministic component (Hood 1998:8, 17). More recent research has shifted to investigating social aspects of these early cultures and asking questions that allow the inhabitants of the distant past to be viewed as people who had agency (e.g., Friesen 2007; LeMoine 2003; Milne 2003a, 2005). Investigations of sites located in the interior regions of Arctic islands have expanded our understanding of Pre-Dorset and Dorset cultures, improving upon earlier interpretations that were largely based on excavations of coastal sites. The classic definitions of Pre-Dorset and Dorset lifeways have persisted for decades. The Pre-Dorset are viewed as small bands that were constantly in motion, moving between resource patches and taking advantage of a limited variety of the available subsistence resources (Bielawski 1988:56; Darwent 2004:68; Milne and Park 2016:696). In contrast, the Dorset are viewed as living a sedentary life on the coast, where they took advantage of every resource available to them, moving only when these resources were depleted (Darwent 2004:68; McGhee 2001:117; Milne et al. 2012:280; Odess 1998:420). New evidence counters these culture historical constructions.

Recent research has demonstrated that the published interpretations of Pre-Dorset and Dorset land use practices do not reflect the patterns observed on southern Baffin Island. Investigations by Milne (2003a, 2005, 2008) focused on identifying how the limited chert availability on southern Baffin Island impacted the decisions made by Pre-Dorset people regarding the scheduling of their activities. Her research demonstrated that because toolstone is geologically restricted to the interior of southern Baffin Island, chert procurement was a driving factor in Pre-Dorset mobility (Milne 2003a:300). This is contrary to most models of hunter-gatherer seasonal rounds, where toolstone procurement is presumed to be embedded in other activities (Binford 1979:259; Milne 2003a:300). The interior region was important not only as a reliable source of chert toolstone, but it also played an important social role (Milne 2003a, 2005, 2008; Milne et al. 2012). The interior region is easily reached from nearly any point along the south coast of Baffin Island (Milne 2008:186; Milne et al. 2013:57), making it an ideal location to gather with groups from distant communities to visit, meet potential spouses, and exchange information (Milne 2008:184; Milne et al. 2013:57). It was also the best place for younger members of the community to develop skills such as flintknapping, owing to the abundance of chert toolstone, which ensured that novice mistakes would not compromise the group's toolstone stores (Milne 2003a:308, 2005:338; Milne et al. 2014). Trips to the interior were opportunities not only to develop new skills but also set the stage for enculturation where young community members also learned what their attitude should be towards these skills, their environment, and the required resources (Milne 2005; Milne et al. 2014). Milne (2003a) questions long-held notions which state that women had little involvement in stone tool manufacture (Finlay 1997:204; Gero 1991:163; Hayden and Hutchings 1989:238–239). She argues that because trips to the interior played a significant social role in enculturation and bringing people together to find marriage partners, *all* members of Pre-Dorset society—including young women—would have participated in a flintknapping apprenticeship (Milne 2003a:309).

Research focused on the large multi-component site known as LdFa-1 in the deep interior of southern Baffin Island has demonstrated that Late Dorset people in this region practiced the same patterns of mobility as their Pre-Dorset ancestors, travelling seasonally between the coast and the interior (Landry 2013; Milne et al. 2012). Landry (2013) analysed debitage from the Late Dorset component of LdFa-1 and compared his results to the two interior Pre-Dorset sites that Milne (2003a) examined in her dissertation—Mosquito Ridge (MaDv-11) and Sandy Point (LlDv-10). This comparison demonstrated that the occupants at all three sites were intensively reducing chert in the interior for transportation to the coast (Landry 2013:71). As such, it can be inferred that the interior region likely held similar social significance for Dorset people as it did for their Pre-Dorset ancestors (Milne et al. 2013:58).

LdFa-1 is well situated to engage in caribou hunting and investigation of the faunal assemblage found that caribou was hunted intensively at this site by Late Dorset people (Milne et al. 2012:278, 2013:53–54). The presence of all skeletal elements indicates that the animals were hunted nearby and the highly fractured nature of caribou bone in this assemblage demonstrates that they were processed to extract marrow (Milne et al. 2013:55). This is consistent with the land use practices observed at Pre-Dorset sites where warm seasons were spent in the interior reducing chert and hunting caribou (Landry 2013:72; Milne et al. 2013). Most importantly, it contradicts the assumption that Dorset people rarely ventured inland, preferring to stay within a day's travel of their coastal camps (McGhee 2001:117; Milne et al. 2012:280).

As more archaeological investigations are conducted in the eastern Arctic the lines between previously defined cultural traditions are becoming increasingly blurred. As early as 1988, Bielawski (1988:71–72) began to question if differences between Independence I and Pre-Dorset cultures reflected different approaches to survey and excavation more than actual cultural separation. This question continues to be a focus in eastern Arctic archaeology. Many researchers have argued that the differences that divide Pre-Dorset and Dorset into distinct cultural traditions have been overemphasized, and the similarities between the two are greater than their differences. Therefore, they should be viewed only as temporal divisions within a single culture (Landry 2013:25; Maxwell 1973:296, 336, 1976:74; Nagy 1994:9).

Ryan (2016:775) has proposed that now that we have a better understanding of the diagnostic artifacts that represent each Palaeo-Inuit culture, it is necessary to revisit the collections from all the "type sites" that were originally used to define these archaeological cultures. This recommendation follows recent excavations at Tyara (KkFb-7)—the type site for Early Dorset. These excavations have revealed a previously unidentified Pre-Dorset component and multiple Dorset components. Ryan argues that mixing of these components led to the original designation of this site as Early Dorset; however, recent radiocarbon dates have demonstrated that it actually dates to the Middle Dorset period (Ryan 2016:774). Re-evaluation of material from sites designated as Pre-Dorset may be especially informative, because early research grouped any site that could not be ascribed to Dorset or Thule traditions into this "catch-all" category (Milne and Park 2016:703).

As archaeological investigations proceed, we must continually re-evaluate our long-held assumptions of what defines a cultural tradition. As further examples of Dorset sites are identified in the interior regions of Arctic islands, we must reconsider the definition of these people as sedentary and coastal adapted. Revisiting type sites as Ryan recommends may see us redefining the divisions that we currently use to separate material culture into cultural traditions.

4. Theoretical Framework and Research Hypotheses

This chapter describes the two theoretical perspectives used to interpret the results of the LbDt-1 debitage analysis. The two perspectives — technological organization and agency theory — are commonly used in lithic studies, and were used here to investigate hypotheses regarding quarry use, flintknapping skill acquisition, and the relationship among sites on southern Baffin Island. These hypotheses and related test expectations are stated at the end of the chapter. Descriptions of the lithic reduction sequence, characteristics of quarries, the field processing model, and knowledge transmission systems are also discussed as they provide the background information required for this study.

4.1 The Lithic Reduction Sequence

Flintknapping is a reductive process where stone tools are made from rocks through the removal of individual flakes until the desired product is achieved (Shott 1994:69). This process results in predictable patterns in the lithic debitage that is produced, which can be interpreted to define stages of the reduction sequence. As each flake is removed, less cortex is retained on the objective piece. The flakes removed later in the sequence have less cortex and higher dorsal scar counts than those removed in the early phases of reduction (Ahler 1989a:89–90; Magne 1989:17; Maudlin and Amick 1989:73). However, not all material will have cortex to remove. Lithic raw materials that are mined from veins will have no cortex and nodule size also influences the initial amount of cortex (Bradbury and Franklin 2000:43). Thus, measurement of this attribute is not relevant for all lithic studies. Throughout the reduction process, both the objective piece and the waste flakes decrease, proportionately, in size and weight. Therefore, we can infer that large flakes represent the early stages of reduction, while small flakes are primarily produced during the later stages (Ahler 1989a:89; Bradbury and Franklin 2000:43). Platform attributes also provide clues regarding what stage of the reduction continuum is represented. Flakes removed earlier in the sequence are more likely to have unmodified, minimally modified, or crushed platforms representing hard hammer percussion techniques. Those removed later in the sequence tend to be more carefully prepared and detached, and are associated with soft hammer and/or pressure flaking techniques (Cotterell and Kamminga 1987:698; Hayden and Hutchings 1989:240; Morrow 1997:63; Tomka 1989:146–147). Platform preparation among the later reduction stages provides a flintknapper with greater control over the shape of the resulting flake, while reducing accidental breakage of the objective piece (Dibble 1997:157; Morrow 1997:62). When considered together, these attributes can be used to differentiate debitage representing the early, middle, and late stages of tool production.

4.2 Raw Material Procurement and Patterns of Quarry Use

Stone tool manufacture is generally staged at different sites across the landscape (Binford 1979:268; Ericson 1984:4; Nelson 1991:79). When tool production is staged in this way, the debitage left behind can inform our understanding of how people both used and moved through the landscape, and we can infer how sites articulate with one another within a larger regional land use pattern (Nelson 1991:79).

The lithic reduction sequence begins at quarries or secondary source areas where lithic raw material is procured. Procurement may require specialized extraction tools or can be as simple as collecting cobbles from riverbanks (Ericson 1984:4; Gramly 1980:824). Lithic raw material procurement can occur in any of three ways. It can be direct, where people travelled to quarries or other source locations to collect lithic raw material for themselves (Andrefsky 1994:23; Ericson 1984:6); procurement may occur through trade with groups located closer to sources of good-quality raw material (Morrow and Jefferies 1989:29); or it can be embedded within other activities and collected opportunistically while pursuing other resources (Beck and Jones 1990:285; Binford 1979:259).

When direct procurement strategies were used, trips to quarries tended to be brief because these sites were visited for the sole purpose of toolstone procurement. This specific use of the site is reflected in the lack of structural features at most quarries (Ericson 1984:7; Gramly 1980:829; Lautzenheiser et al. 1996:38–39). Another possible explanation for the absence of structures is the concept of quarries as "neutral ground" where access was unrestricted to all local groups (Ericson 1984:7). Extended occupations also may not have been practical because quarries were not necessarily located in areas where subsistence resources are immediately available (Kelly 1988:718).

The first stages of stone tool production include material selection and testing for quality. These stages would always take place at source areas as it would be inefficient to transport material from the quarry to another location only to discover it is poor quality (Binford and O'Connell 1984:415; Burke 2007:72). Raw material testing produces large quantities of debitage and this is reflected in quarry assemblages that are massive and dominated by early stage reduction flakes (Ericson 1984:3; Nelson 1991:80; Shott 2015:560). In certain situations, formal tools such as bifaces were completed at quarries rather than workshops (Ericson 1984:4). "Dumping" behaviour at quarries is associated with people anticipating "gearing up" at these sites, and even tools that could be repaired or recycled were often discarded at quarries because the abundance of fresh stone made tool maintenance at these locations unnecessary (Andrefsky 1994:23; Gramly 1980:829; Keeley 1982:803–804). Many of the discarded tools present at the quarry may be made from non-local materials because people commonly used multiple raw material sources throughout the year (Gramly 1980:828).

Once material was tested and good-quality nodules were selected, they were typically reduced at the quarry into tool preforms and/or prepared cores. These cores and preforms were then removed from the quarry to be further reduced at workshops (Dibble et al. 2005:546). Workshops tend to be situated at locations where subsistence resources were readily available, and more time could be spent on tool production owing to the ease at which subsistence needs could be met (Milne and Donnelly 2004:102). From there, tools were brought to residential sites where they were used, maintained, and recycled into other forms (Gramly 1980:829). Eventually, these tools were exhausted, recycled, or liquidated and discarded at the site where they were last used or were discarded when the group returned to the quarry or encountered another raw material source. Recycling and liquidation behaviours are most common when groups are far from known lithic sources (Andrefsky 2009:77). These behaviours make it difficult to identify diagnostic tool types as they result in drastic changes to the original tool form (Andrefsky 2009:67).

4.3 The Organization of Technology

This theoretical perspective encourages researchers to investigate the decisions past people made around their technology. The most important concepts within this perspective are the notions of planning and technological strategy. Contrary to evolutionary models that view technology as the result of people making tools to adapt to their environment, the perspective of technological organization argues that a group's technology is carefully planned and is not entirely responsive to their environment (Nelson 1991:59). It allows the focus of research questions to turn towards humans and the decisions they made around their technology; rather than working back from the final product of those decisions (Nelson 1991:59).

Nelson (1991:57) defines the organization of technology as "…the study of the selection and integration of strategies for making, using, transporting, and discarding tools and the materials needed for their manufacture and maintenance." Viewing the archaeological record from the organization of technology perspective highlights decisions made by past people regarding which strategies were used to meet their needs in light of the resources available to them, the tasks for which tools were required, group mobility, and the availability of time to make and maintain tools within other scheduled activities (Nelson 1991:60; Torrence 1983:12, 1989:60). These decisions were influenced by many variables including social, environmental, and economic factors (Burke 2007:65; Koldehoff 1987:154; Nelson 1991:57). Owing to the many variables that had to be considered when selecting how technology should be organized, different technological strategies would be used by groups in different environments, and by the same group as their activities and priorities shifted throughout the year (Bamforth 1986:49; Binford 1979:255; Nelson 1991:65).

4.3.1 Technological Strategy

The organization of technology is often broken into two strategies: curation and expediency. A third, less frequently discussed strategy known as opportunism may be used in conjunction with either of these strategies (Nelson 1991:62). These strategies are differentiated by the amount of time and energy that was invested in tool production.

Curation

Curated tools are "formal types" that are highly retouched, and standardized in form and style (Andrefsky 1994:22, 2009:71; Bamforth 1986:38). Tools of this kind involved a greater investment of time, and were transported to numerous locations throughout their use-life

(Bamforth 1986:38; Nelson 1991:62). Binford (1973:242, 1979:263) observed that because curated tools were transported, there is a disconnect in the archaeological record between the locations where they were made, where they were used, and where they were discarded.

Curation extends the use-life of a tool through maintenance and recycling, and reduces the need to procure raw material and make new tools. Therefore, curation is often interpreted as a strategy for conserving lithic raw material (Bamforth 1986:39). The observation that curation is conservative of raw material led some researchers to suggest that this technological strategy can be linked with high levels of mobility. Proponents of this idea have noted that mobile populations moved in and out of range of lithic sources throughout their seasonal round (Andrefsky 1994:22; Kelly 1988:718; Ricklis and Cox 1993:444). The use of a curated technological strategy would compensate for a group's limited access to raw material, as formal tools could be maintained through resharpening and be reused rather than replaced through the procurement of new raw material to fashion new tools (Andrefsky 1994:22; Kelly 1988:719). Use of this technological strategy balances a mobile population's need to invest in tool production and maintenance with their need for tools to be ready for use (Nelson 1991:63).

Use of the term curation has been heavily criticized by archaeologists who argue that this concept has not been well defined and means different things to different researchers. Critics argue that this inconsistency has devalued the term (see Nash 1996; Shott 1996). Despite these criticisms, the use of the term persists and many archaeologists continue to use the concept in their interpretations of lithic technology (e.g., Akoshima and Kanomata 2015; Kristensen et al. 2019; Quinn et al. 2019). For the purposes of this study, Nelson's (1991:62) definition of curation is used; she defines it as: "…a strategy for caring for tools and toolkits that can include advanced manufacture, transport, reshaping, and caching or storage."

Expediency

Curation is often viewed in opposition to expedient technology, which maintains the connection between tool production, use, and location (Bamforth 1986:38; Binford 1979:243; Nelson 1991:82). Expedient or informal tools are highly variable in form, and little time is invested in their production. Expedient tools were produced when needed with little concern for style, and therefore lack characteristics that could be used to identify individual preferences or forms that are representative of a group (Binford 1973:243). Expedient strategies are sometimes considered to be wasteful of raw material because tools were used and discarded without resharpening them to prolong their use-life (Andrefsky 1994:22). These tools tend to be associated with more sedentary populations who are presumed to have lived adjacent to sources of lithic raw materials, and thus could use the more wasteful expedient technology without suffering any raw material stress (Andrefsky 1994:22). However, it has been argued that wastefulness would not have been a concern because expediency was only practiced when a group was familiar with the area and could plan their activities around locations where raw material was available; when a group knew they had access to stockpiled raw material; and when time stress was not a concern (Nelson 1991:64).

Although curation and expedient strategies are often linked with specific settlement patterns, it is important to note that this pattern is not a rule (Andrefsky 2009:71; Nelson 1991:87). People in the past had to consider many variables other than their settlement strategies that were specific to their personal or group circumstances. When making decisions around their technological organization, they may have used multiple technological strategies to effectively cope with different situations. Andrefsky (1994) provides three case studies from the western United States that support this point. He demonstrated that lithic raw material abundance and quality are more significant factors than settlement patterns in determining which technological strategy was used. The importance of raw material availability is discussed in detail in section 4.3.2.

Opportunism

Opportunistic strategies can be difficult to distinguish from expedient technologies as both yield hastily produced, unstandardized tools that were made, used, and possibly discarded in the same location. The difference is that opportunistic strategies were used to adapt to unexpected situations (Binford 1979:267; Nelson 1991:65–66). The unplanned nature of opportunistic tool making might be recognizable in the archaeological record if less desirable or unusual materials were substituted for those typically used for a task, indicating that the people using them had to "make do" with materials that were immediately available (Binford 1979:266; Ricklis and Cox 1993:457).

The three technological strategies of curation, expediency, and opportunism are not mutually exclusive. A single group may use all three technological strategies depending on the tasks at hand, the availability of fresh toolstone, time constraints, and unexpected circumstances (Nelson 1991:65).

Design

Expanding on the three technological strategies described above, Nelson (1991:66) adds five design strategies that contribute to how a group organizes their technology. These designs include reliability, maintainability, flexibility, versatility, and transportability. Many variables are considered in tool manufacture, and which design is emphasized depends on the context of tool use (Nelson 1991:66).

Reliable designs include tools that are “over-designed” indicating that they are built to be stronger than is necessary for their intended tasks to ensure they will not break during use. Reliable tools are designed to be used at a moment’s notice (e.g., when game is encountered) and, therefore, are manufactured prior to their use and are well maintained after each use (Nelson 1991:66–68). Nelson discusses maintainable, versatile, and flexible designs together as they are very similar, and result in generalized tool types. These designs differ from reliable strategies in that they are intended to be used in several contexts. Maintainable and flexible designs are manufactured with the expectation that tools will change in form to cope with needs as they arise (Nelson 1991:70). In contrast, tools made using versatile designs do not change in form but are used in a multitude of tasks (Nelson 1991:70–71). Lastly, transportable toolkits are lightweight and have few items. If a toolkit has fewer items, more of them need to be used in a variety of situations, therefore, transportable toolkits often involve more general designs that would also be considered flexible or versatile (Nelson 1991:73–74). An additional consideration of transportable technologies is that they are carried into areas where replacement materials may be scarce, and so more conservation of material and tool maintenance is expected (Nelson 1991:74).

There are trade-offs in using any of these design strategies. Maintainable/flexible and versatile designs are convenient because they can be used for a number of different tasks. However, they are less efficient than reliable tools, which are task specific but require more time in manufacturing and maintenance (Nelson 1991:71).

Although a group’s technological organization is tied to a number of cultural variables such as their mobility, economy, and social institutions, it is also inseparable from the geological conditions of their local environment (Burke 2007:65).

4.3.2 Lithic Raw Material Availability and Other Considerations

The link between settlement systems and technological organization has been debated since the 1980s. Most researchers agree that technological strategies are affected more by lithic resource availability and diet breadth than settlement patterns (Andrefsky 1994; Bamforth 1986:40; Kelly 1988:719; Torrence 1983, 1989). Andrefsky (1994:23) believes that raw material availability is the single most important factor in a group's technological organization. He demonstrates this point using three case studies in areas with differential access to lithic raw material and differing material quality (Andrefsky 1994:23). His study found that regardless of settlement strategy, areas where abundant, high-quality lithic raw material is found both informal and formal tool types will be used (i.e., both curated and expedient strategies). If material is high quality but scarce, formal tool production will be favoured over informal tools. In areas where poor-quality material is abundant, informal tools dominate the assemblage. The same is true when material is poor quality and scarce (Andrefsky 1994:29–30). Conversely, Nelson (1991:77) notes that "[i]f raw material is unavailable, it is because humans have made social, economic, and technological decisions that create the condition." This suggests that raw material availability is not necessarily a driving factor in technological strategy making, rather it is a by-product of those decisions. Decisions affecting a group's access to lithic raw material might include where they choose to reside, their degree of mobility, and socioeconomic structures that might make specific materials unattainable to particular individuals or groups within a society.

Diet breadth, time stress, and risk are also viewed as important factors in deciding a group's technological strategy (Torrence 1989). Torrence (1983:18) argues that groups relying on a greater variety of subsistence resources (especially plant foods) can use simpler, expedient technologies. When a group cannot risk hunting failures because they have limited options for alternative subsistence resources, such as the Inuit who rely heavily on meat. They reduce that risk through toolkit design; Inuit toolkits are "risk adverse" including tools that are complex, task specific rather than generalized, and are over-engineered reliable tools that are continuously maintained (Torrence 1989:63; see also Binford 1979:263). When technology is viewed as risk adverse it is clear that the technological strategy of curation is not used to conserve raw material, rather it is used to ensure that tools are available when they are required (Torrence 1989:64). This strategy ensures that there are no scheduling conflicts between tool production and maintenance and tool use (Torrence 1983:12).

These examples demonstrate that it is necessary to consider multiple variables when discussing a group's technological organization. The decisions made by a group about their technology were influenced by many factors including raw material availability, tool function, scheduling of tool production and maintenance, requirements such as tool kit transportability, flexibility, versatility, and risks of tool failure (reliability).

4.3.3 The Field Processing Model

The field processing model used to study lithic procurement systems is derived from the central place foraging model applied to faunal analyses (Beck et al. 2002:486; Kessler et al. 2009:145; Shott 2015:549). Both of these models assume that resources occur in their raw form away from their locations of use and must be processed to increase their utility (Shott 2015:548).

According to the field processing model, there were three factors to weigh when a group was deciding whether it was more effective to reduce material in the field or to bring it back to camp unmodified. The first is processing time, the second is the amount that the processing increases the utility of the product, and the last consideration is the distance that must be travelled to reach the residential site (Beck et al. 2002:487). Most studies that have used the field processing model focus primarily on the transport distance (e.g., Beck et al. 2002; Kessler et al. 2009; Shott 2015). In these studies the model is used to predict how lithic reduction was staged by estimating the intensity of lithic reduction (i.e., field processing) that can be expected to occur at different locations based on the distance lithic raw material had to be transported (Beck et al. 2002:486; Shott 2015:549).

The field processing model assumes that there is a direct relationship between intensity of lithic reduction at quarries and the distance that raw material had to be transported. When quarries are located at a significant distance from locations of tool use, intensive lithic reduction can be expected to take place at quarries. When the distance between a quarry and a residential site is small, less extensive reduction is expected (Beck et al. 2002:492; Kessler et al. 2009:149; Shott 2015:549, 552). In their description of the field processing model, Beck and colleagues (2002:493) cite ethnographic reports that state that daily foraging trips were usually no more than a 20-30 kilometer round-trip. This provides a threshold that can be used to define a "significant distance." As such, any resource extraction site located more than 15 kilometers from a residential site can be expected to be a location where at least some field processing would occur based on the model's predictions. The underlying assumption is that people make decisions based on efficiency, and that it is more efficient to reduce raw material to a later stage at quarries located far from residential sites so that objects are lighter to transport (Shott 2015:549–550). The model predicts that this would maximize the amount of usable material transported to the residential site during each trip to the quarry, and would reduce the frequency that groups had to engage in long distance travel to lithic sources (Beck et al. 2002:486; Shott 2015:549–550). Proponents of the field processing model argue that another benefit of extensive field processing is that it would allow the identification of material flaws at the quarry, prior to transport, thus reducing the cost of manufacture breaks as broken pieces could be discarded and immediately replaced owing to the abundance of material at quarries (Shott 2015:549–550). When the distance between the quarry and the residential site is short, it may have been more efficient to do less processing at the quarry, instead making more frequent trips there, as reducing it at the camp could be done as needed or scheduled for "down time" (Beck et al. 2002:486; Nelson 1991:79).

A main critique of the field processing model is that it is environmentally deterministic, emphasizing the distance that material had to be transported, over the decisions people were making (Garvey 2015:159, 167). Even so, the field processing model provides a reasonable baseline to predict past behaviour at quarries that is useful in forming hypotheses. When the field processing model is viewed within an organization of technology framework, it is clear that other factors would have affected a group's decisions around field processing practices (Garvey 2015:159; Torrence 1989:64). These factors might include group mobility, mode of transportation (e.g., on foot versus by kayak), distribution and quality of raw material, the number of people present at the quarry, caching practices, craft specialization, desired tool types, locally available subsistence resources, and competing demands for time (Andrefsky 1994; Binford and O'Connell 1984; Close 1996; Garvey 2015; Ricklis and Cox 1993; Torrence 1983).

4.4 Agency and the Social Relations of Production

Agency theory encourages archaeologists to recognize that the artifacts we study were made by human beings who had complicated social lives that involved more than adapting to conditions for survival (Clark 2000; Dobres and Hoffman 1994; Sassaman 2000).

Acknowledging agency allows researchers to suggest explanations for variation in the archaeological record through the actions of individual people in the past.

Agents are defined quite simply as individual human beings with the power to make decisions for themselves (Clark 2000:104; Sassaman 2000:149). This approach recognizes that individuals in the past had ideas, desires, and aspirations that may have been in competition with the expectations or demands of their social group or society (Sassaman 2000:149–150). The ability of agents to fulfil their personal desires could be constrained by cultural structures and environmental limitations. Structures are institutions that inform members of a society on social norms, values, and beliefs (Dobres and Hoffman 1994:222). These structures represent the historical context and past precedence of the social group and dictate what is considered appropriate behaviour for an individual belonging to a particular social class, gender, or age cohort (Dobres and Hoffman 1994:222; Perry 2003:120; Wobst 2000:41).

Like structures, the social relations of production also restrain the actions of agents. Many aspects of human behaviour including the production and use of technology are influenced by who is present, where activities take place, and which activities are involved. These three factors provide the context in which the social relations of production operate (Dobres 1995:29). The rigidity of the social relations of production is dependant on a group's social organization and can change throughout the year as the group is reorganized to pursue different activities (Milne 2003a:88). Investigations of technological variation can reveal how rigid the social relations of production were within a society by indicating the extent that deviation from standard templates was restricted or tolerated (Brumfiel 2000:253; Dobres 1995:41; Wobst 2000:45).

Choosing to produce a tool using different techniques, materials, or styles could be risky because people in the past used their technology to define themselves and their culture or membership in a social group (Dobres 1995:28; Dobres and Hoffman 1994:219; Nelson 1991:61–62; Wobst 2000:47). In societies where status was achieved rather than ascribed, the risk an agent takes by choosing to do things differently may be beneficial as they had the potential to improve their social ranking through the demonstration of expert skill, innovation, or access to raw materials or final products (Dobres 1995:40–41). Alternatively, if an agent could not increase their status, they might choose to demonstrate their displeasure with existing social structures or their own circumstance by producing artifacts that do not conform to the standards of the social group (Wobst 2000:45). In either of these scenarios, individual agents have the power to maintain the "status quo" by producing artifacts using traditional techniques and materials, or to initiate cultural change by choosing to do something different (Sassaman 2000:149). Each of these strategies should be visible through identification of variation in archaeological assemblages.

Emphasizing the agency of past people has been criticized for focusing on only a single segment of a past society's population (usually high status individuals or those competing for increased status), while the actions and decisions of individuals in the larger social group are ignored (Clark 2000:100–101). Agency approaches are also viewed as sometimes imbuing agents with omnipotent knowledge of the exact outcomes of their actions, making them less believable as human beings (Clark 2000:100–101). Lastly, and perhaps most importantly, when using agency there is a tendency towards ethnocentrism where researchers are compelled to "put themselves in the shoes" of agents in past society and view the circumstances of people in the past in light of our own (Brumfiel 2000:253–254; Dobres and Robb 2000:13). However, if researchers are cognizant of these limitations and are careful to avoid these pitfalls, including agency in archaeological investigations can improve our understanding of people in the past and their role in shaping the societies in which they lived.

4.4.1 Flintknapping Skill Acquisition

There are many ways in which learning is structured, and it varies by culture and circumstance (Bamforth and Finlay 2008:9). Multiple methods of learning were probably used by the Palaeo-Inuit depending on which skills were being acquired, and some skills were likely learned using a combination of knowledge transmission techniques.

The three methods used in learning flintknapping are observation, trial and error, and scaffolding. Which of these methods was selected to educate people in flintknapping would have been decided in part by access to lithic raw material (Eigeland 2011:132; Ferguson 2008:53). Trial and error methods produce the most waste while observation and scaffolding techniques are conservative of raw material (Ferguson 2008:60). A novice's first introduction to flintknapping would have been through observation of adults maintaining their stone tools in camp. Children would become familiar with the basic tenets of flintknapping procedures, and which tools and materials are used in the craft at a young age simply from being in the area where these tasks were performed. However, observation alone cannot provide the necessary information to become a proficient flintknapper; it is a task that requires practical experience and practice to master (Bamforth and Finlay 2008:8).

Knowledge transmission activities associated with flintknapping are expected to occur most frequently at lithic quarries where raw material is most abundant (Bamforth and Finlay 2008:17; Ferguson 2008:54; Finlay 1997:209; Goldstein 2019:685; Milne 2014:108). In these contexts, evidence of trial and error learning is expected as there would be no need to conserve lithic raw material (Ferguson 2008:53). These experimental flintknapping activities are readily identifiable in the archaeological record through the repetitive errors novices make when learning to flintknap (Cunnar 2015:134; Ferguson 2008:63; Goldstein 2019:686; Milne 2005:336; Viken and Darmark 2018:527). (These characteristic errors are described in detail in Chapter 6.)

In areas where raw material is scarce or restricted geologically, journeys to quarries were important milestones for young flintknapping apprentices (Eigeland 2011:136; Goldstein 2019:685). Journeying to the quarry would create an atmosphere that impressed the importance and seriousness of embarking on a lithic apprenticeship (Eigeland 2011:136; Goldstein 2019:685). The physically demanding nature of these journeys would require that novices had developed the stamina and strength necessary to make such a journey, thus apprenticeships in regions with few lithic source areas may have been delayed until novices reached a certain age or maturity level (Ferguson 2008:53; Milne 2014:109). These journeys would have been opportunities for young people to learn not only about flintknapping, but also to strengthen their bonds with elder members of their community and others in their age cohort while reinforcing cultural values, traditions, and attitudes, along with learning rituals, identification of useful plants, patterns of animal behaviour, stories associated with specific places on the landscape, and navigational landmarks (Goldstein 2019:685, 706; Milne 2014:109–110).

Ethnographic records of Inuit lifeways state that most learning was achieved through observation, and trial and error rather than direct teaching (Park 2006:55, 2018:216). This method was favoured among the Inuit because children were viewed as reincarnations of recently deceased community members, who only needed to be reminded of what they already knew (Park 1998:272, 2006:55). However, because childhood is a cultural construct, it is important to remember that the path to adulthood is understood differently depending on culture (Högberg 2008:113; Park 2006:54). As such, it cannot be presumed that this notion of childhood and attitude towards learning was similar in Palaeo-Inuit societies. While ethnographic reports have provided a good understanding of how Inuit children learned hunting and other skills through the toys and games that they enjoyed, and material correlates of toys recovered from Thule sites indicate that childhood learning experiences for the Thule and Inuit were similar, there is no evidence to suggest that the same was true for the experience of Palaeo-Inuit children (Park 1998:280, 2006:60, 62, 2018:220, 225). The lack of clear evidence for Dorset toys indicates that learning and enculturation may have been shaped differently for Palaeo-Inuit children than they were for the Neo-Inuit (Park 1998:280, 2006:60, 2018:221).

4.5 Multiscalar Approach

Archaeologists tend to limit their research to certain scales whether spatial or temporal. A microscale study might focus on a single time period or a single site, while macroscale studies may investigate changes in a culture or region over time or compare sites within a region (Marquardt 1992:107). In this study, a multiscalar approach is applied on the spatial scale because the lithic reduction sequence is often staged among sites located across the landscape (Binford 1979:268; Ericson 1984:4; Nelson 1991:79). The macroscale deals with questions on a broader regional scale, defined here as southern Baffin Island. Milne's (2003a) investigation of four debitage assemblages from Palaeo-Inuit sites on southern Baffin Island (MaDv-11, KkDn-2, KkDo-3, and LlDv-10) provide data for comparison with the LbDt-1 debitage assemblage to develop macroscale interpretations. Microscale analyses are focused on lithic reduction activities at LbDt-1. By identifying debitage patterns at a single site and then expanding the scale of inquiry to the broader region, relationships between each site in the study area are revealed.

4.6 Statement of Hypotheses and Test Expectations

The following is a brief review of pertinent points. From the previous chapters we know that Pre-Dorset and Dorset people living on southern Baffin Island relied on chert to produce their stone tools, and that chert is geologically restricted to the interior region of southern Baffin Island. In section 4.1 the lithic reduction sequence was described, noting that because lithic technology is reductive, the chert used in stone tool production had to be replaced regularly. To replace exhausted chert tools people had to travel inland to procure raw chert at quarries. The field processing model discussed in section 4.3.3 predicts that when quarries are located at a significant distance from residential sites more reduction should take place at the quarry. Lastly, quarries are expected to have the highest incidence of novice activities owing to the abundance of raw material at these locations.

4.6.1 Hypothesis One and Test Expectations

Hypothesis one argues that LbDt-1 was an important place for Palaeo-Inuit novices to gain practical experience in flintknapping, and that the site was a significant source of lithic raw material for Palaeo-Inuit people occupying Mosquito Ridge (MaDv-11), Sandy Point (LlDv-10), Shaymark (KkDn-2), and Tungatsivvik (KkDo-3). The interior of southern Baffin Island has previously been identified as the best place for Palaeo-Inuit people to procure the chert necessary to maintain their toolkits (Milne 2008:185). This is because the interior is where chert is available geologically (ten Bruggencate et al. 2015:190). The coastal regions lack the sedimentary outcrops that produce chert, making knappable stone difficult to find (Maxwell

1973:10). Procurement of the raw material required Palaeo-Inuit people to engage in regular long-distance travel to the interior from the coast during the warm season to acquire this necessary resource (Milne 2014:105). These trips to quarry sites such as LbDt-1 were important for enculturation of young community members, providing them with an opportunity to engage in flintknapping activities in an environment where raw material was abundant and their errors would not threaten the group's chert supply (Cunnar 2015; Finlay 1997; Milne 2005:337, 2014:108).

This hypothesis suggests that LbDt-1 fits into the lithic reduction sequence observed in previous research as the missing point of procurement and early stage reduction of the continuum. Earlier research identified the interior sites of Sandy Point (LlDv-10) and Mosquito Ridge (MaDv-11) as workshops where the early and middle stages of lithic reduction (preform production and core reduction) were the main lithic activities (Milne 2005:340–341). The debitage assemblages from Tungatsivvik (KkDo-3) and Shaymark (KkDn-2) represent the later stages of tool production and maintenance, which are complementary to those from Sandy Point (LlDv-10) and Mosquito Ridge (MaDv-11), and demonstrate that preforms were transported from the interior to be completed at these coastal sites (Milne 2003a). Likewise, patterns of novice activity differ between the two regions, with evidence of novice activities being found at Mosquito Ridge (MaDv-11) and Sandy Point (LlDv-10) and an absence of novice work at Tungatsivvik (KkDo-3) and Shaymark (KkDn-2) (Milne 2012:132–133). These differences were determined to be related to the differing availability of chert toolstone in the two regions (Milne 2012:138).

This hypothesis suggests that novices participated in flintknapping at LbDt-1 to a greater degree than at any other site in the study owing to its special status as a quarry. It also suggests that patterns of lithic reduction at LbDt-1 indicate that it acted as the point of procurement and early stage reduction of the reduction continuum, connecting the quarry to the comparative sites.

If this hypothesis is valid, I expect that:

1. The debitage at LbDt-1 will overwhelmingly represent early stage reduction. Evidence is observed in attributes primarily representing hard hammer direct percussion including: large or crushed platforms, eraillure scars, the presence of bulbs of percussion and compression rings, a lack of evidence for platform preparation or pressure flaking (Ahler 1989b:211; Hayden and Hutchings 1989:240), low frequencies of smaller flakes (Bradbury and Franklin 2000:42), and a high frequency of cortex bearing debitage with low dorsal scar counts (Ahler 1989b:211; Dibble et al. 2005:546).
2. There will be high frequencies of tested cobbles and shatter.
3. There will be a higher frequency of debitage displaying evidence of low skill at the quarry (Cunnar 2015:135; Finlay 1997:209; Milne 2005:335). Evidence of low skill including stacked step fractures near platforms and the use of too much or too little force that resulted in unsuccessful flake detachments evidenced by step, hinge, snap, and outrepassé terminations. This uncertainty regarding the amount of force required also translates into large bulbs of percussion, pronounced compression rings, and eraillure scars when too much force was applied. Novices also produce higher frequencies of shatter (Ahler 1989b:217; Milne 2005:331, 334; Shelley 1990:188–191).
4. Lithic reduction by novices at the quarry will be restricted to hard hammer direct percussion, as this is the simplest flintknapping method (Hayden 1989:11). If a

novice's first experience with flintknapping occurred at the quarry, the focus of this initial lesson was likely how to judge the quality of raw material. This is achieved using hard hammer reduction and would not require the transportation of billets and pressure flaking tools to the quarry if there was no plan to complete tool production or maintenance at this location (Hayden 1989:14). Therefore, no discarded billet or pressure flaking tools will be present at the quarry, and there will be no debitage representing these reduction techniques.

5. There will be little evidence for platform preparation or preform manufacture (Milne 2005:331, 340; Shelley 1990:191).
6. There will be the most evidence for novice work at LbDt-1, but more at the interior habitation sites compared to the coast owing to their closer proximity to the quarry (Milne 2005:337).
7. There will be a statistically significant relationship between site type, location, and skill.

4.6.2 Hypothesis Two and Test Expectations

This alternative hypothesis states that LbDt-1 does not articulate with the comparative sites selected for this study, and that the quarry was not a significant location for the intergenerational transmission of flintknapping skill. If novices were not engaging in lithic apprenticeships at LbDt-1 they had to be taught this skill at other locations. If this were true, and novices were learning flintknapping at sites where chert is not available for experimentation, more observation and scaffolding techniques would have been necessary to pass on flintknapping skill. These methods of knowledge transmission leave fewer identifiable material correlates. This hypothesis argues that Palaeo-Inuit people were replacing exhausted tools at LbDt-1 when fresh chert was available (Gramly 1980:828). It also suggests that lithic apprenticeships did not include experimentation at LbDt-1, and thus may have involved a formal teaching style that relied more on verbal instruction, observation, and scaffolding methods.

If this hypothesis is true, I expect that:

1. The full sequence of tool manufacture debitage will be present at LbDt-1. This is demonstrated by the presence of a highly variable debitage assemblage representing all size grades, varying cortex percentages and a range of manufacture techniques identified by platform states representing hard hammer and billet percussion as well as pressure flaking (Bradbury and Franklin 2000:43; Hayden and Hutchings 1989:237).
2. Numerous exhausted stone tools would be present at LbDt-1 as they were discarded and replaced into haft elements with newly manufactured stone tools (Gramly 1980:826).
3. Some discarded exhausted tools are manufactured from exotic materials (Burke 2007:71; Gramly 1980:830).
4. Discarded incomplete tools that were broken during manufacture or aborted due to raw material flaws will be present in the lithic assemblage (Burke 2007:70; Gramly 1980:825).
5. There will be no more evidence of novice flintknapping at LbDt-1 than is present at any of the comparative sites.
6. Each site will have a similar amount of variation in skill within their debitage assemblage.

7. If scaffolding techniques were used for knowledge transmission, novice activities will be difficult to discern on completed tools, but they may be visible in the debitage (Ferguson 2008:63).
8. There will be no relationship between site type, location, and flintknapping skill.

4.6.3 Hypothesis Three and Test Expectations

This null hypothesis states that when LbDt-1 is compared to the other sites, there will be no differences among them in terms of lithic reduction stage and flintknapping skill levels. This hypothesis suggests that workable chert was available near all the comparative sites, making trips to LbDt-1 for chert procurement and lithic apprenticeship unnecessary because these activities could be satisfied elsewhere/anywhere.

If this hypothesis is correct, then I expect:

1. All the sites will have similar frequencies of tools and cores.
2. Debitage from the quarry will be indistinguishable from that of the habitation sites in terms of technological attributes.
3. There is evidence of expert and low skill at each site regardless of proximity to the quarry.
4. There is no relationship between site type, location, and flintknapping skill.

5. Methodology

This chapter outlines the methodological approach adopted for the investigation of the LbDt-1 quarry lithic assemblage. It begins with a brief definition of debitage as an artifact category, which is followed by a discussion of two methods commonly used to study lithic debitage: individual attribute and aggregate analysis. The chapter concludes by describing the statistical applications used to isolate and identify patterns in the acquired data.

5.1 Debitage as an Artifact Category

Lithic technology is reductive in nature involving the systematic removal of material from an objective piece of stone (e.g., a core or tool). Stone waste, flakes collectively termed debitage, are the by-product of this process and are produced throughout all stages of stone tool manufacture, resharpening, repair, and rejuvenation (Ahler 1989a:86; Andrefsky 2005:16, 2007:392). Flakes are detached from the objective piece using various techniques including direct, indirect, bipolar, and pressure flaking (Andrefsky 2005:12, 28; Cotterell and Kamminga 1979:101; Hayden 1989:11-12). Although, a completed tool may be the goal of a reduction episode, the debitage generated provides valuable information for interpreting past behaviours. Not only is debitage the most common artifact type in the archaeological record (Andrefsky 2005:16; Fish 1981:374), it tends to be left where it was created, making it an especially useful indicator of site function and past land use patterns (Ahler 1989a:86; Magne 1989:15; Odell 1989:163). Debitage links discrete locations to specific reduction activities (e.g., core reduction, preform production, tool maintenance). It is unusual for a complete reduction sequence from raw material testing to tool thinning and edging to occur at a single location. More often, preforms or cores produced in one location were reduced as needed while people moved across the landscape. Tools were carried with people as they traversed the landscape, and were resharpened and maintained prior to use and throughout subsequent use episodes (Hayden 1989:12). The identification of debitage patterns and inter-site comparisons of these patterns allows researchers to determine which stages of the reduction continuum are represented at each site. This comparison allows us to link sites together to see spatial patterns in how lithic reduction activities were staged and by proxy, how people used their landscape (Beck et al. 2002:496–497).

Debitage is easily differentiated from tools, cores, and naturally occurring broken rock. It is distinguished from tools and cores based on positive percussion features and an absence of post-detachment modification. These positive features include bulbs of percussion, compression rings, and eraillure scars that are identified on the interior surface of a detached flake (Andrefsky 2005:20; Cotterell and Kamminga 1979:102, 108, 110; Patterson 1983:300; Sullivan and Rozen 1985:758). These attributes along with striking platforms and patterned dorsal scarring are absent on naturally fractured rocks (Barnes 1939; Patterson 1983). Tools are flakes or blanks that have been intentionally modified for use in specific tasks. The term "formal tool" refers to implements that require an investment of time and effort to produce, and have a "flexible" design meaning they can be resharpened or reconfigured for use in a variety of tasks (Andrefsky 1994:22). The flexible design of formal tools results in gradual changes to their appearance throughout their use-life, as they are frequently reworked by removing flakes through the processes of resharpening and repair (Andrefsky 2005:30). For example, a tool may begin its use-life as a biface but as it is reduced through resharpening or breakage, it may be modified for use as a scraper, drill, or other tool before it is completely exhausted and discarded (Andrefsky 2005:34–36). These transformations are responsible for the wide range of morphological variability among certain formal tool types (Andrefsky 2005:32). Occasionally, formal tools were reduced to such an extent that they are no longer recognizable as tools and are ‘invisible’ in the archaeological record (Magne 1989:19). Formal tools are often “curated” meaning that efforts were made to prolong their use-life and they were transported among many sites, eventually being discarded far from where they were produced (Andrefsky 1994:22, 2005:31; Bamforth 1986:38; Nelson 1991:62). Informal or expedient tools are minimally modified, maintaining most of the attributes of the original flake. They often exhibit retouch or use along only a single flake margin and lack standardized forms (Andrefsky 2005:31; Doelman 2005:13; Milne 2003a:117). These tools require little time or effort to produce and tend to be discarded immediately after use, typically within the site that they were made. Cores are characterized by negative flake scars across all surfaces and can be typed as unidirectional, multi-directional, bipolar, or bifacial, each representing a different reduction strategy (Andrefsky 2005:16).

5.2 Analytical Methods

The focus of this research is the artifacts that can be used to study novice flintknapping skill. While some formal tool types, such as bifaces and scrapers are known to display attributes indicative of novice tool making skill, very few were recovered from LbDt-1 (Milne 2005; Shelley 1990; Weedman 2002). The tools that were recovered were not examined in detail, as they tend to be informal types that lack characteristics attributable to novice flintknapping. Indeed, many of the items identified here as tools could be also classified as debitage, including the cores, burin spalls, and blade-like flakes. This would leave only the two possible microblades and two end scrapers in the tool category. Flakes that appeared utilized were included with the debitage, but retouched flakes were classified as expedient tools because they display evidence of deliberate post-detachment modification. I examined cores and core fragments, as many of them indicate novice flintknapping skill, and in the context of a quarry site these artifacts can be classified as debitage (Gramly 1980:825, 1984:16). This is based on the assumption that cores were selectively removed from the quarry for reduction elsewhere and, therefore, usable cores were not deposited at the site (Beck et al. 2002:485).

Two methods commonly used for lithic debitage analysis are individual attribute and aggregate analysis. These methods have both been criticized when independently applied to debitage assemblages, but most researchers view these approaches as complementary, generating multiple lines of evidence that combine to produce meaningful results that can be used to infer past human behaviours (Anderson and Hodgetts 2007:231; Bradbury and Carr 2009:2794; Carr and Bradbury 2004:21; Morrow 1997:51-52). These methods were used to study the debitage assemblage from the quarry site LbDt-1. Summary and descriptive statistics were used to identify and interpret patterns of variability within the debitage assemblage.

5.2.1 Individual Attribute Analysis

Individual attribute analysis focuses on defining specific attributes on lithic artifacts relating to raw material, technology, function, morphology and post-depositional processes (Landry 2013:46; Milne 1999:42, 2003a:121). These attributes are investigated on the assemblage level, which emphasizes variability within the assemblage and allows researchers to avoid the problems associated with using artifact typologies (Milne 1999:42). Studying the frequency of attributes occurring within an assemblage can provide insights into what the intended products were, and which flintknapping techniques, activities, strategies, or tools were used during the reduction process (Ahler 1989b:210-211; Andrefsky 2009:80, 88; Hayden and Hutchings 1989:253; Morrow 1997:62-63; Tomka 1989:139, 157).

Critics of individual attribute analysis point out how time consuming and tedious it can be (Ahler 1989a:86-87; Bradbury and Franklin 2000:42), but of greater concern, are the factors that can lead to inconsistent results, such as the skill of the analyst, subjectivity, and the selective recording of attributes which makes it difficult to compare results between similar studies (Ahler 1989a:86; Milne 1999:42, 2003a:121; Odell 1989:167). It is common for researchers using this method to focus only on complete and proximal flakes, but this practice runs the risk of biasing their results (Ahler 1989a:86; Bradbury and Franklin 2000:42; Milne 1999:42). There is also the issue that flakes appearing to be technologically specific may be produced by a variety of techniques, which has led some researchers to question the utility of this method (Ahler 1989a:87, 1989b:211; Sullivan and Rozen 1985:757-758). Despite these critiques, individual attribute analysis can be a useful tool for investigating assemblage variability and technological strategies used at a site, provided certain measures are taken. If a researcher examines complete assemblages and clearly defines the attribute states recorded, biases can be avoided (Milne 1999:42, 2003a:122).

5.2.2 Aggregate Analysis

Aggregate analysis was developed as a fast, objective, and easily replicable alternative to individual attribute analysis to be used for the investigation of large debitage assemblages (Ahler 1989a:87; Bradbury and Franklin 2000:42; Morrow 1997:55). This method differs from individual attribute analysis in its division of an assemblage into size grades, which shifts the focus from the attributes of individual flakes to the dimensions and weights of debitage across specific size categories. The content of each size grade is counted, weighed, and the number of flakes retaining dorsal cortex is recorded. These attributes provide the necessary information to determine which stages of lithic reduction are represented within an assemblage. Based on the reductive nature of lithic technology, it is expected that as a stone is reduced the number of large, heavy flakes with cortex should occur less frequently as tool production progresses, and small flakes with no cortex should dominate the later reduction stages. These distributions are compared to debitage patterns established through experimental flintknapping to infer what techniques, strategies, and tools were used to create the assemblage, as well as to determine the purpose of the flintknapping episode (e.g., core reduction or tool production) (Ahler 1989a:87–89; Andrefsky 2007:393; Bradbury and Carr 1995:111; Carr and Bradbury 2004:27).

Like individual attribute analysis, there are issues with aggregate analysis that have been raised. This method has been criticized for: lacking direct links between assemblage patterns and human behaviour (Ahler 1989a:88-89); its inability to differentiate mixed assemblages (Ahler 1989a:89; Andrefsky 2007:396, 2009:82-83; Bradbury and Carr 1995:111; Morrow 1997:56); neglecting to consider site processes that may result in size sorting (e.g., trampling, erosion, bioturbation, cleaning) (Morrow 1997:56); and for failing to recognize that raw material characteristics and flintknapping technique, style, and skill level impact size grade distributions and cortex retention rates (Andrefsky 2007:394-395, 2009:82-83; Bradbury and Carr 1995:106; Sullivan and Rozen 1985:756). One of the strengths of this method is its incorporation of all size grades and inclusion of broken flakes. Researchers using individual attribute analysis regularly exclude the smallest size grades and broken flakes to reduce their sample size, but this practice introduces biases that are avoided when aggregate analysis is used (Ahler 1989a:86; Bradbury and Franklin 2000:42).

5.2.3 Methodological Approach for LbDt-1

To overcome the shortcomings that aggregate and individual attribute analysis are criticized for when used individually, both methods were used in the analysis of LbDt-1. Through the application of this multiple method approach, I was able to develop multiple lines of complementary evidence. Additionally, by using both of these methods the data generated through the investigation of LbDt-1 are directly comparable to Milne's (2003a) analyses of four debitage assemblages from southern Baffin Island: Mosquito Ridge (MaDv-11), Sandy Point (LlDv-10), Shaymark (KkDn-2), and Tungatsivvik (KkDo-3). These data were analysed using statistical tests to inform my interpretations regarding technological organization and flintknapping skill at the five sites investigated.

Aggregate analysis is an appropriate method for my investigation of the quarry site LbDt-1, because it is most effective when applied to assemblages comprising large accumulations of debitage with little technological variation (Andrefsky 2007:398; Bradbury and Carr 2009:2788; Morrow 1997:56). By using this method in conjunction with individual attribute analysis it can eliminate the biases inherent in individual attribute analysis through the examination of complete assemblages (Ahler 1989a:87-88; Andrefsky 2009:81; Carr and Bradbury 2004:22). Individual attribute analysis likewise compensates for aggregate analysis' inability to differentiate between mixed assemblages and reveals comprehensive information regarding the technological strategies represented by an assemblage.

5.3 Attributes Selected for LbDt-1 Debitage Analysis

The attributes measured in the analysis of LbDt-1 were modified from Landry (2013) and Milne (1999, 2003a) both of whom used individual attribute and aggregate analysis to study similar Palaeo-Inuit lithic debitage assemblages. A total of thirteen attributes reflecting variability in lithic raw material, reduction strategies, and site disturbance were recorded for each specimen (Landry 2013:49; Milne 1999:42). Attribute definitions and the processes I followed for recording these attributes are presented in Appendix A.

5.3.1 Raw Material Attributes

Raw material attributes include lithic type and quality. These attributes were minimally recorded because as a chert quarry, it was expected that the LbDt-1 assemblage would be dominated by chert. Raw material colour and texture were not recorded because these attributes can have a wide range of variation within a single piece of Baffin Island chert making visual sourcing methods unreliable and highly subjective (Andrefsky 2009:78; ten Bruggencate et al. 2015:192; Milne 2003a:312). Raw material attributes such as quality, nodule size, and shape would have influenced decisions made by Palaeo-Inuit tool makers regarding their strategies of technological organization. For example, in areas where quality is variable, tool makers may have opted to conduct more material testing prior to transport, as this would ensure that only usable, good-quality material was transported back to their basecamp (Beck et al. 2002:486; Ericson 1984:6). If nodules occur only in small packages, flintknappers may be limited to bipolar reduction strategies because it is difficult to reduce small materials using controlled freehand knapping techniques (Koldehoff 1987:167).

Together, these attributes provide information that allows researchers to assess the availability of local lithic resources, the distance material was transported from its source, inter-regional trade and interaction. These details have the potential to provide insights into the strategies used by Palaeo-Inuit people to maintain their lithic technology.

5.3.2 Technological Attributes

Debitage attributes that provide insights into the technological choices made by flintknappers include: weight, size, dorsal scar count, dorsal cortex, platform modification, platform battering, bulbs of percussion, compression rings, and eraillure scars (Landry 2013:49).

These attributes assist in determining at which stage of the reduction sequence a flake was detached, the type of hammer or percussor that was used in its production, and provide insights into the skill of the flintknapper (Cotterell and Kamminga 1987; Hayden and Hutchings 1989; Milne 2005; Shelley 1990).

Flake weight, size, cortex, and dorsal scar count reflect the lithic reduction stages present at a site. As tool production progresses, predictable patterns emerge within a debitage assemblage. The objective piece being worked becomes smaller, as do the flakes removed from it (Ahler 1989a:89-90; Andrefsky 2007:398; Bradbury and Franklin 2000:42; Carr and Bradbury 2004:22). These patterns demonstrate that large, heavy flakes, with few dorsal scars and/or a high percentage of cortex are associated with early stage reduction, while small, light flakes, with high frequencies of dorsal scars and little to no cortex represent late stage reduction (Ahler 1989a:90; Anderson and Hodgetts 2007:231-234; Bradbury and Franklin 2000:42). Additionally, the amount of dorsal cortex present provides data concerning the original package size and shape of nodules available and indicates reduction stages. Small flakes with high percentages of cortex indicate the original nodule was small (Anderson and Hodgetts 2007:243-244; Bradbury and Franklin 2000:42, 50; Dibble et al. 2005:547; Sullivan and Rozen 1985:756).

These attributes are determined in part by flintknapping techniques—hard hammer direct percussion tends to produce the largest, thickest, and heaviest flakes, while pressure flaking produces the smallest, lightest, and highest volume of flakes when compared to other reduction methods (Ahler 1989a:91; Andrefsky 2005:118-119; Dibble and Pelcin 1995:436; Hayden and Hutchings 1989:237).

Platform modification, battering, bulbs of percussion, compression rings, and eraillure scars are associated with the type of hammer or billet used in flake detachment, the amount of force applied to the objective piece, and the skill of the flintknapper (Cotterell and Kamminga 1979; Hayden and Hutchings 1989:237; Milne 2005:331; Shelley 1990:191). Platform modification relates to the reduction stage and the amount of time invested in flintknapping. An unmodified platform indicates no time investment and early stage reduction. In contrast, an advanced platform featuring multiple facets or grinding demonstrates that the flintknapper prepared the platform to provide greater control over the detachment of the resulting flake. Prepared platforms are more common later in the reduction continuum since greater care and control is required to ensure flakes are successfully detached, and it reduces the potential that the tool will break or fail (Dibble 1997:151; Hayden 1989:14). Prepared platforms may be paired with platform trimming, which is the removal of overhanging material from the platform area. Stacked battering occurs when repeated blows are struck at the same location, indicating a failure to successfully detach a flake from the larger objective piece. This characteristic is often attributed to novices because an experienced flintknapper would recognize their error and adjust their approach, while novices lack the experience to understand why the detachment was unsuccessful and will continue to repeat the same mistake (Milne 2005, 2012:124; Shelley 1990). The presence of bulbs of percussion, compression rings, and eraillure scars indicate that heavy force loads were applied to the objective piece and suggest that hard hammer techniques were used. When these attributes are very pronounced, they indicate excessive force was applied in flake detachment—a common error in novice flintknapping (Andrefsky 2005:26; Milne 2005:331, 334; Shelley 1990:191).

While these attributes are defined as technological, they cannot escape the effects of raw material properties. Flake size and weight are constrained by the size, shape, and raw material quality of the original nodule from which they are struck, and inclusions may cause failure preventing the force from passing through the stone resulting in an unsuccessful flake detachment (Cotterell and Kamminga 1987:678; Dibble 1997:151). This is an important consideration for my investigation of LbDt-1 where low-quality chert occurs in small, irregularly shaped nodules.

5.3.3 Post-Depositional Attributes

Attributes associated with post-depositional processes include debitage completeness and distal termination. Debitage completeness documents the transformations that debitage undergoes after it becomes part of the archaeological record. These attributes reflect fracturing owing to trampling or other site formation processes (Nielson 1991; Prentiss and Romanski 1989:94). Debitage completeness was recorded based on Sullivan and Rozen's (1985:759) interpretation free debitage categories. This method applies mutually exclusive attributes to classify the degree of debitage completeness. Unlike typologies, which are often poorly defined, subjective, and cannot capture the full range of variability within an assemblage, these categories are "interpretation free" because they do not equate a piece of debitage with a specific tool type or reduction stage (Sullivan and Rozen 1985:756, 758). For example, the typological category "bifacial thinning flake" indicates that the debitage resulted from late stage biface production; however, this kind of classification can mask the range of variation that occurs within debitage assemblages (Sullivan and Rozen 1985:759). Distal termination states communicate if a flake detachment was successful. The success of a detachment is measured by the distal termination type—a feather termination is considered successful, while a step or snap termination represents an incomplete or failed detachment. The success of a flake detachment is affected by raw material quality and the skill of the flintknapper. For example, insufficient force may result in a hinge termination, while material flaws or trampling may result in a snap termination (Cotterell and Kamminga 1987:700; Prentiss and Romanski 1989:95).

5.4 Data Evaluation and Statistical Analyses

The statistical analyses used to summarize, compare, and interpret patterns identified among the debitage were calculated using the open-source statistical software RStudio. Descriptive statistics, measures of central tendencies, and measures of dispersion were used to compare and contrast the thirteen attributes recorded among all five lithic assemblages from the respective sites included in this study. Using the results of these statistical analyses, chi-squares were calculated to determine if there was a relationship between specific variables. For example, the variables of site location, size grade, weight, and dorsal cortex were used in chi-square equations to determine if a relationship exists between reduction stage and region; likewise, site location, platform battering, platform modification, and distal termination were used to examine relationships between flintknapping skill and region. Levene's test for homogeneity of variance was also used to determine if differences observed in variance or standard deviation were statistically significant.

5.4.1 Descriptive Statistics

Percentage frequencies and frequency distributions, were calculated to indicate general trends in the data (Milne 1999:47). These measures were calculated for each of the five sites included in this study to determine how often specific attributes occurred within the assemblages. These statistics were individually calculated and graphed for each of the thirteen attributes recorded during lithic analysis. This facilitated inter-site comparisons, which isolated patterns of variability among the assemblages, providing the data that were used to infer differing regional strategies for the use and organization of lithic technology.

5.4.2 Measures of Central Tendencies

Measures of Central Tendencies were used to summarize the data and indicate what attributes were most common within an assemblage. The mode was used to isolate the attribute states that occurred most frequently within the assemblage (e.g., the most common platform modification), although it may not represent the middle of the distribution (Healey 1996:63-64). This measure is limited because it is possible that there is no mode, or there may be multiple modes. This may occur if all cases within a variable share similar frequencies, such as if there is a relatively even distribution of all platform modifications throughout the dataset. When this occurs, the mode ceases to be a meaningful indicator (Healey 1996:64). The mode is useful because it can be used on any data type. As such, it provides a simple method to compare the frequency of each attribute between assemblages, which can be used to infer which sites demonstrate specific reduction stages and flintknapping skill levels.

The median is limited to ordinal (i.e., ranked) data. Therefore, this measure was restricted to the variables of weight and dorsal scar count (Healey 1996:65). The median is used to determine which value is the exact centre of a distribution (Healey 1996:64); this measure is most useful when compared to the mean because it demonstrates the direction of data skewing (Healey 1996:69).

The mean is the most commonly used measure of central tendency and is typically the metric used when "averages" are calculated (Fletcher and Lock 2005:36). The popularity of the mean measurement stems from its incorporation of all available data, providing that the data are recorded as an interval-ratio measurement (Fletcher and Lock 2005; Healey 1996:67). The downside of this, however, is that the mean is vulnerable to skewing by outliers in the data at either extreme of the continuum (Fletcher and Lock 2005:37; Healey 1996:69). The mean is calculated by summing the values recorded for an attribute and dividing it by the number of cases. For the LbDt-1 dataset, the mean can only be applied to the variables of weight and dorsal scar count as no other variable is measured on an interval-ratio scale. The means of these two attributes were calculated for each size grade within the five sites. This measure is useful because it provides an easily interpretable value that can be compared between assemblages to determine how much variability exists among sites. These attributes indicate stages in the reduction continuum, and regional patterns can be assessed based on which sites have the highest and lowest mean flake weights and dorsal scar counts.

To overcome the limitations of each measure of central tendency, I have calculated them all for each appropriate variable. This facilitated comparison between datasets and highlighted patterns and skews within the data.

5.4.3 Measures of Dispersion

Measures of central tendencies are most informative when used in association with measures of dispersion (Healey 1996:90). By contrasting these two measures we can determine how accurately they describe the data and what effect outliers have on the distribution (Madrigal 1998:40). Measures of dispersion indicate the level of variation (or lack thereof) within a specific variable by providing a measure of the clustering or spread demonstrated by the data (Drennan 2009:27; Healey 1996:90).

Range measures variability, which is the distance between the variables at the two extremes of the dataset. It is calculated by subtracting the lowest value from the highest value in a dataset (Drennan 2009:27), ignoring the variables in between, which makes the range vulnerable to skewing (Fletcher and Lock 2005:42; Healey 1996:93). For my dataset, this measure could only be applied to the weight and dorsal scar count, but it provides a method for the comparison of variability of these attributes between size grades and sites.

Standard deviation is the most commonly used measure of dispersion (Fletcher and Lock 2005:47). It is a more accurate measure of variation than range, as it includes all available data. This measure is based on the mean, therefore it can only be used when investigating interval-ratio data (Drennan 2009:29; Healey 1996:67). As such, standard deviations could only be calculated for weight and dorsal scar counts. Standard deviation measures the distance between each value within the dataset and the mean while emphasizing larger deviations (Fletcher and Lock 2005:47-48). The standard deviation is easy to interpret as the value that results from its calculation is expressed in the same units as the original data (e.g., grams). The value increases with more variation, while values closer to zero indicate less variation (Drennan 2009:313; Healey 1996:105).

5.4.4 Chi-Square

Chi-square calculations are used to determine if a statistically significant relationship exists between two variables (Fletcher and Lock 2005:129). It compares frequencies observed in the data to those expected as outlined in the null hypothesis (H_0) (Fletcher and Lock 2005:129). The null hypothesis assumes that variables are independent, if this is true there should be little difference between the expected frequencies and the observed frequencies. If the differences are significant, the null hypothesis can be rejected, indicating that the variables are dependent

(Healey 1996:251–252). When calculated, a high scoring chi-square indicates that a relationship exists between the two variables (i.e., they are dependant), while a score closer to zero indicates no relationship (i.e., they are independent) (Fletcher and Lock 2005:131). The significance of chi-squared test result can also be assessed using the p-value. When a chi-squared test returns a p-value that is less than 5% (0.05), the null hypothesis can be rejected with 95% confidence and we can conclude that the variables are dependant (Fletcher and Lock 2005:63–64).

5.4.5 Levene's Test for Homogeneity of Variance

Levene's test for homogeneity of variance was used to determine if the differences in standard deviations (σ) observed for various attributes within the dataset were statistically significant (Levene 1960). Significance was determined through rejection of the null hypothesis (H_0), which assumes that variances (σ^2) between populations are equal (Levene 1960:287). The null hypothesis could be rejected with 95% confidence when Levene's test returned a p-value that was less than 0.05.

By using a multi-method approach for the analysis of the LbDt-1 debitage assemblage some common sources of bias can be avoided in the results. The statistical approaches described above will facilitate the comparison of my analysis of LbDt-1 to Milne's (2003a) research on Mosquito Ridge (MaDv-11), Sandy Point (LlDv-10), Shaymark (KkDn-2), and Tungatsivvik (KkDo-3). This comparison will inform my interpretation of how Palaeo-Inuit peoples organized their lithic technology at these five sites.

6. Debitage Analysis, Statistical Results, and Interpretations of LbDt-1

Using a combined methodological approach of aggregate analysis and individual attribute analysis, I was able to isolate and identify the stages of lithic reduction present at LbDt-1 as well as the reduction strategies that were used. This chapter describes these patterns as they relate to variability in lithic raw material, technological choices, and post-depositional processes. I also present my interpretations of how these patterns reflect site function and toolmaker skill (Landry 2013; Milne 2003a, 2005). Finally, I compare my findings between the upper and lower components of LbDt-1 to determine if site activities may have been spatially segregated in the larger site area.

6.1 Raw Material Information

The lithic raw materials represented in the LbDt-1 assemblage are exclusively chert, with colours ranging from shades of grey to tan. The entire assemblage is poor-quality chert due to the presence of imperfections in each specimen that range from embedded fossils, vugs, voids, and tiny inclusions (Figure 6.1). This is consistent with chert recorded at other sites on southern Baffin Island (Milne 2003a:311–312). Chert at the quarry is found outcropping from limestone bedrock on the beach at the river level (the lower component) and is eroded in small, irregular nodules (Landry et al. 2019). Once freed from the limestone by this weathering process, small nodules of chert can easily be collected from the surface without the use of extraction tools (Landry et al. 2019; Milne 2013:23). Geophysical investigations of the upper component at LbDt-1 have demonstrated that in some areas the debitage deposit is between 10 and 15 cm deep, and the substrate underlying the debitage deposit is fine-grained sand and soil rather than bedrock (Landry et al. 2019). Because the underlying sediment is soil, it demonstrates unequivocally that the debitage deposit is the result of human activity rather than natural processes.

Figure 6.1 Examples of lithic raw material from LbDt-1 showing fossils, vugs, and inclusions.

6.2 Technological Attributes

Technological attributes provide information about the lithic reduction stages represented in an assemblage and techniques that were used to reduce the stone. Aggregate analysis of the LbDt-1 assemblage found that the majority of the lithic debitage are small (size grade 1), light flakes with little cortex (Figure 6.2). This result likely reflects that the initial size of nodules being reduced was small, rather than representing later stages of lithic reduction. This is consistent with observations that raw material available on southern Baffin Island occurs as small nodules (Milne 2005:340).

6.2.1 Size Grades

Previous authors have noted that as lithic reduction progresses, both the size of flakes and the objective piece decrease; therefore, flakes removed later in the reduction sequence tend to be smaller than those removed in earlier stages (Ahler 1989a:89; Andrefsky 2007:398). Based on this premise, size grades were used as one line of evidence to infer reduction stages. However, it is important to note that many small flakes are produced throughout the reduction sequence, which may be exceptions to this rule (Magne 1989:16). At LbDt-1, the two smallest size grades (size grades 1 and 2) dominate for both flakes and shatter (Table 6.1, Figure 6.2).

Table 6.1. Size grade distribution for LbDt-1. Percentages represent frequency of debitage type per size grade.

Size Grade	1 (< 6.3 mm)	2 (6.3> < 12.5 mm)	3 (12.5 > < 19 mm)	4 (19 > < 25 mm)	5 (25 > < 31.5 mm)	6 (>31.5 mm)
Flakes	43.98% (n=1422)	36.25% (n=1172)	13.83% (n=447)	4.45% (n=144)	1.11% (n=36)	0.37% (n=12)
Shatter	29.55% (n=443)	37.76% (n=566)	19.95% (n=299)	7.67% (n=115)	3.80% (n=57)	1.27% (n=19)
Full Assemblage	39.41% (n=1865)	36.73% (n=1738)	15.77% (n=746)	5.47% (n=259)	1.97% (n=93)	0.66% (n=31)

6.2.2 Weight

Other researchers have noted that as a continuous variable, weight has greater potential to show variability than discrete data such as size grades can (Ahler 1989a:90). This variability is of interest in that it may reflect that light (or thin) and heavy (or thick) flakes produced during different stages of lithic reduction or using different technologies (e.g., hard vs. soft hammer) can be found together within a size grade (Carr and Bradbury 2004:28). At LbDt-1, weight provided complementary data to the size grade information. The distribution of weight is similar to the size grade data, where the highest frequencies of light flakes are in the smallest size grades. Over half of the flake assemblage (68.42%) weighs 1 gram or less (Figure 6.2). These light flakes are clustered within size grades 1 and 2 with a single specimen represented in size grade 3 (Table 6.2). Standard deviations were calculated for the weight of each size grade, which demonstrate that as size grade increases, so does the amount of variability for both flakes and shatter. While the increased variation among the heavier specimens suggests that there are vast differences in debitage shape in the larger size grades, it is actually a reflection of the lower frequency of debitage in the larger size grades. In the LbDt-1 assemblage, weight does not contribute any information that was not already determined by the size grades.

Table 6.2. Summary statistics for debitage weight.

LbDt-1 Weight	Flakes	Shatter	Full Assemblage
Mean	1.868528	4.558446	2.720638
Median	0.34	1.16	0.49
Standard Deviation	4.710534	9.173962	6.585851
Range	64.9	110.05	110.05

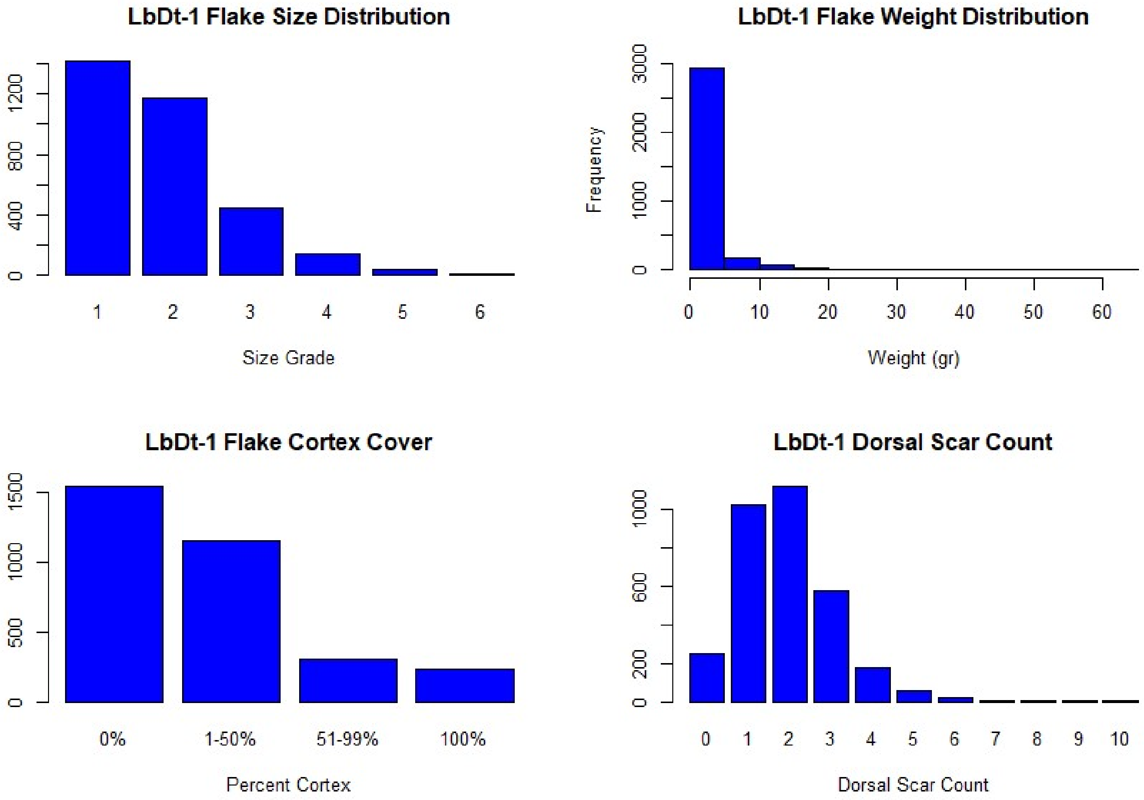


Figure 6.2. Histogram displaying right-skewed distribution for flake weight and bar charts showing flake size grade distribution, percentages of cortex on flakes, and dorsal scar counts.

6.2.3 Cortex

The final attribute examined in the aggregate analysis of the LbDt-1 assemblage is cortex. Cortex can be a useful indicator of reduction stages present at a site depending on the original raw material package (Ahler 1989a:90; Bradbury and Franklin 2000:45). If the parent material worked at a site consists of cortical nodules, the amount and extent of cortex present on debitage can indicate how intense primary reduction may have been and how much of the material was removed from the site for reduction elsewhere. Within the LbDt-1 assemblage flakes with 0% dorsal cortex are most common (Figure 6.2). When size grade is cross-tabulated with cortex, the highest frequency of flakes with 0% cortex occur in the two smallest size grades (Table 6.3).

This is what would be expected if they represent late stage reduction (Ahler 1989a:89–90; Sullivan and Rozen 1985:764). However, the greatest frequency of flakes with any amount of cortex also occurs within size grade 2 (Table 6.3). The high frequency of cortex present on flakes in the smallest size grades contradicts the expectations for flakes representing late stage reduction (Ahler 1989a:90). Rather, it likely indicates that the original nodules being reduced at the site were small (Bradbury and Franklin 2000:45; Dibble et al. 2005:547). This is supported by a chi-squared test, which demonstrates that the relationship between size grade and cortex is dependant (p-value = < 2.2^{-16}). This conclusion is consistent with observations of raw chert nodules at LbDt-1 (Landry et al. 2019; Milne et al. 2014).

Table 6.3. Frequency of cortex on flakes by size grade. Percentages represent portion of flakes in full assemblage.

Cortex	Size Grade					
	1	2	3	4	5	6
0% (0)	28.73% (n=929)	14.44% (n=467)	3.93% (n=127)	0.53% (n=17)	0.062% (n=2)	0
1-50% (1)	10.86% (n=351)	14.85% (n=480)	6.77% (n=219)	2.57% (n=83)	0.46% (n=15)	0.15% (n=5)
51-99% (2)	2.04% (n=66)	3.87% (n=125)	2.1% (n=68)	0.87% (n=28)	0.43% (n=14)	0.22% (n=7)
100% (3)	2.35% (n=76)	3.09% (n=100)	1.02% (n=33)	0.49% (n=16)	0.15% (n=5)	0
Pearson's Chi-Squared Test	X-squared = 446.12, df = 15, p-value < 2.2^{-16}					

6.2.4 Dorsal Scar Count

Like cortex and size grade, dorsal scar count is useful for inferring reduction stages, because each dorsal scar represents a previous flake removal. Therefore, higher dorsal scar counts typically represent later stages in the reduction continuum (Magne 1989:17; Maudlin and

Amick 1989:73).

In the LbDt-1 assemblage, dorsal scar counts on complete flakes range from 0 to 10; however, flakes with two dorsal scars are most common (Figure 6.2). The application of Pearson's chi-squared test found that the variables of size grade and dorsal scar count are dependent (p-value = $< 2.2^{-16}$). The most frequent combination of these attributes is size grade 1 with two dorsal scars. The low dorsal scar count on the smallest flakes corroborates the evidence supplied by the presence of cortex on these flakes, lending further support to an interpretation that they are not finishing flakes despite their small size.

6.2.5 Platform Modification

The types of platform modification represented in an assemblage provide information about reduction stage, reduction technique, and flintknapper skill. Unmodified, crushed, and minimally modified platforms are associated with early stage reduction, hard hammer techniques, and low levels of skill (Hayden and Hutchings 1989:240; Milne 2005:334). Moderate and advance platform modification are most common in later stages of tool production when soft hammer techniques are more likely to be used, and so represent greater competency in flintknapping (Cotterell and Kamminga 1987:698; Milne 2005:331; Morrow 1997:63; Shelley 1990:191).

Of the 3233 flakes in the LbDt-1 assemblage, 46.37% (n=1499) have discernable platforms, of these flakes the most common platform modification is minimally modified (Figure 6.3). Flakes with this platform modification constitute 62.98% of all flakes with platforms. The second most common platform state is unmodified (i.e., cortical) representing 32.89% of platform-bearing flakes. These platform states both indicate early stage reduction. In some instances, however, moderate to advance platform modification at LbDt-1 suggest middle to late stage reduction, while qualitative analyses suggest otherwise. Based on qualitative observations, one of the flakes with advance platform modification in size grade 4 was determined not to be a finishing flake. The platform on this flake had several facets suggesting more careful preparation for removal and greater flintknapping skill. However, it does not match the image of an idealized advance platform, as it was very wide and there was no indication of platform trimming. Also, its classification within size grade 4 indicates that it is too large to represent a late stage finishing flake. There are ten other medium sized flakes (i.e., those in size grades 3 and 4) with advance platforms that can also be ruled out as finishing flakes due to their large size and corresponding heavy weight (ranging from 1.68 to 8.61 grams). These platform modification types are relatively rare at LbDt-1, with moderate preparation identified on only 1.6% (n=24) of platform-bearing flakes and advance preparation observed on 1.33% (n=20) of platform-bearing flakes.

Only 2.9% of flakes demonstrate platform preparation in the form of trimming, indicating that for most of the LbDt-1 assemblage, little effort was invested to prepare the platform for successful detachment (Dibble 1997:157; Hayden and Hutchings 1989:240; Tomka 1989:147).

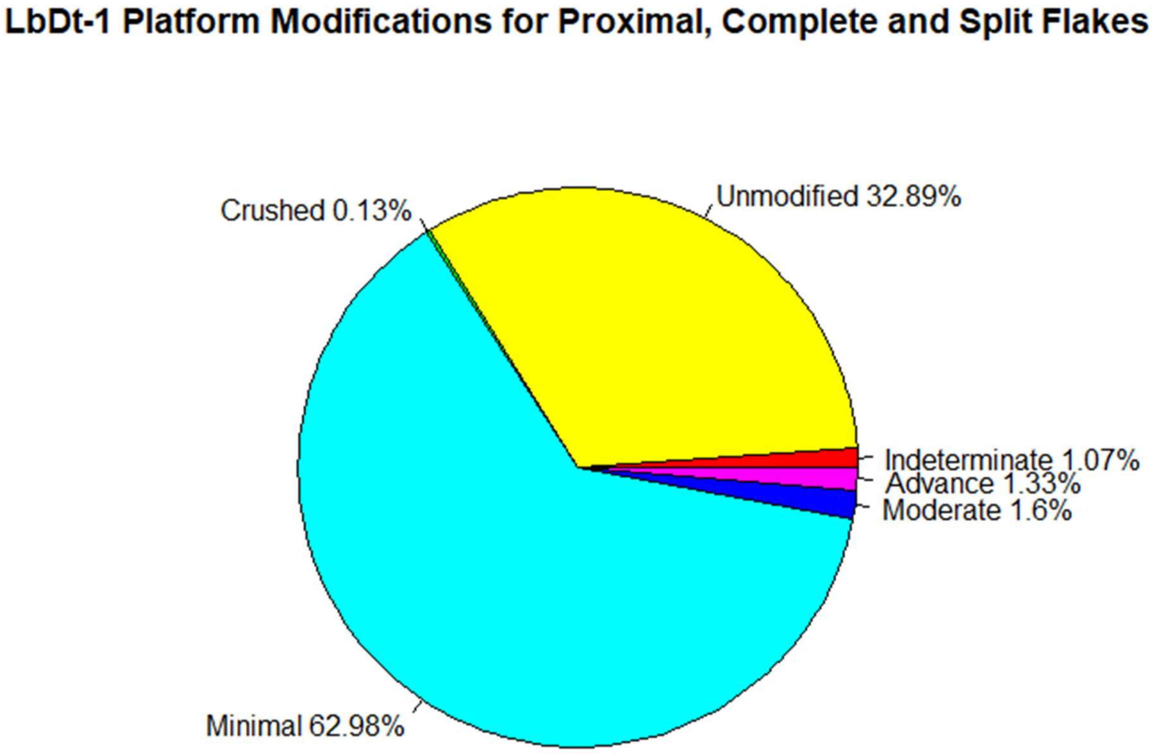


Figure 6.3 Platform modification for LbDt-1 flakes with identifiable platforms.

6.2.6 Platform Battering, Compression Rings, Bulbs of Percussion, and Eraillure Scars

The presence of platform battering, compression rings, eraillure scars, and bulbs of percussion provide information on the percussor and force loads used to produce a debitage assemblage. These four attributes are commonly produced when hard hammer techniques are used (Cotterell and Kamminga 1987:686–687; Hayden and Hutchings 1989:245). Each of these attributes also contributes information regarding flintknapping skill because novices have less control in applying force loads, often using excessive force when attempting flake removals and they have less experience to know at what angles to aim their blows. This lack of experience can lead to stacked platform battering from repeated unsuccessful flake detachments, pronounced bulbs, compression rings, and the production of eraillure scars (Shelley 1990).

At LbDt-1 bulbs of percussion were observed on 49.63% (n=744) of the 1499 platform-bearing, non-shatter flakes in the assemblage. Eraillure scars were noted on 19.08% (n=286), and compression rings are present on 69.65% (n=1044) of the platform-bearing flake assemblage. Only 4.7% (n=70) of platform-bearing flakes collected at LbDt-1 have platform battering (Table 6.5). The relationship between these attributes and novice flintknapping are discussed further in section 6.4. The frequent occurrence of these attributes, in combination with the evidence reflected by platform modification, dorsal scar count, and dorsal cortex, all indicate that the LbDt-1 assemblage represents early stage lithic reduction using hard hammer techniques.

6.2.7 Conclusions

Based on the technological attributes described in the preceding section, the LbDt-1 assemblage is interpreted as representing early stage lithic reduction of small chert nodules produced with hard hammer technology. This interpretation is supported by both the aggregate and individual attribute analyses. The strongest evidence to support this interpretation is the presence of cortex on debitage in the smallest size grades, the low dorsal scar counts on the smallest flakes, the high frequencies of minimally and unmodified platforms, and the high frequencies of bulbs of percussion and compression rings on flakes in the assemblage.

6.3 Post-Depositional Attributes

Post-depositional attributes include debitage completeness and flake termination type. These attributes provide information related to the product of a lithic reduction episode (i.e., core reduction or tool production) and flintknapper skill. However, they are considered post-depositional attributes because they have the potential to be altered after debitage has been discarded, through trampling by animals or by people reusing the site. Debitage completeness is useful for differentiating whether a flintknapping episode represents core reduction or tool production (Sullivan and Rozen 1985), while distal terminations communicate the success of a flake detachment. Each of these attributes can also reflect flintknapper skill (Milne 2005:331; Shelley 1990:188, 191).

6.3.1 Completeness

At LbDt-1 the combined proximal and medial-distal flake fragments outnumber the complete flake and shatter categories (Table 6.4). This pattern could be related to several factors including: the types of lithic reduction occurring at the site, raw material quality, taphonomic processes such as trampling, and flintknapper skill. Each of these factors has the potential to contribute to higher frequencies of broken flakes over complete flakes and shatter.

The lithic reduction processes related to tool production tends to result in more broken flakes than does core reduction (Prentiss and Romanski 1989:89; Sullivan and Rozen 1985:773). Thus, if lithic activities at LbDt-1 were focused on tool production it would provide one explanation for the higher frequency of broken flakes. However, this possibility can be ruled out as the evidence provided by high frequencies of minimally and unmodified platforms and low dorsal scar counts described in the previous section do not support an interpretation that tool production was an important activity at this site. Additionally, the high frequency of shatter in the assemblage (31.68%, n=1499) indicates that the primary reduction technique was hard hammer reduction, which is associated more with early stage core reduction than tool production. Likewise, the lack of discarded exhausted tools, or tools discarded due to a material flaw or error during manufacture suggests that tool production was not an important activity at this site.

Another possible explanation for the high frequency of broken flakes is that they are a by-product of the poor-quality raw material available at the site, as poor-quality chert has higher flake detachment failure rates due to internal flaws (Milne 2005:331). As such, when this stone is worked, the number of broken flakes will be higher than if high-quality internally homogeneous stone was worked. A third possibility is that the high frequency of broken flakes at LbDt-1 is a product of trampling by either people or animals, which has been documented to result in flakes breaking medially (Prentiss and Romanski 1989:94). Alternatively, the high frequency of broken flakes may reflect that inexperienced flintknappers were working at this site as they produce higher frequencies of broken flakes since they often strike an objective piece with too little force, resulting in microfractures, which eventually detach as broken flakes (Shelley 1990:191).

Table 6.4. LbDt-1 assemblage completeness by count and percentage.

Completeness	Shatter (1)	Medial-Distal (2)	Split (3)	Proximal Fragment (4)	Complete (5)
Count	1499	1734	9	280	1210
Percent	31.68	36.64	0.19	5.92	25.57

6.3.2 Distal Termination

The success or failure of a flake detachment is represented by its distal termination type, and can be related to a number of factors including raw material quality and flintknapper skill (Milne 2005:331). However, the effects of trampling can also impact distal termination type, potentially transforming one type into another. The distal termination type was recorded for each individual flake as either absent or indeterminable, feather, step, hinge, outrepassé, or snap.

Of the 3233 flakes in the LbDt-1 assemblage, 2950 have discernable terminations (i.e., proximal fragments and those with absent or indeterminable terminations are excluded). However, if proximal fragments are excluded snap terminations may be under-represented (Figure 6.4). Therefore, all flakes were included in the following discussion. Feather terminations are considered successful and represent more competent skill levels. This is the most frequent termination type recorded at LbDt-1, present on 67.27% (n=2175) of flakes. In the LbDt-1 assemblage snap terminations comprise 20.14% (n=651) of the flakes. Snap terminations can be produced when an objective piece is struck with too much force, which is a common novice error (Milne 2005:331). This high percentage may reflect the poor-quality chert available at the site, as snap terminations can occur when the force wave travelling through an objective piece is obstructed by a flaw causing it to stop short (Cotterell and Kamminga 1987:700), or it could be amplified by the effects of trampling (Prentiss and Romanski 1989:95). At LbDt-1 hinge terminations are present on 12.09% (n=391) of the assemblage, while step terminations are present on only 0.37% (n=12). Hinge and step terminations both occur when an objective piece is struck with insufficient force to successfully detach a flake, a mistake associated with novice flintknappers (Cotterell and Kamminga 1987:701; Milne 2005:331). The presence of snap, hinge, and step terminations suggest that flintknappers with lower skill levels were actively working stone at LbDt-1. The remaining 0.12% (n=4) of the flake assemblage are those that have absent or indeterminable terminations. The absence of outrepassé terminations is not surprising, given the lack of evidence for blade production at the site (Cotterell and Kamminga 1987:701).

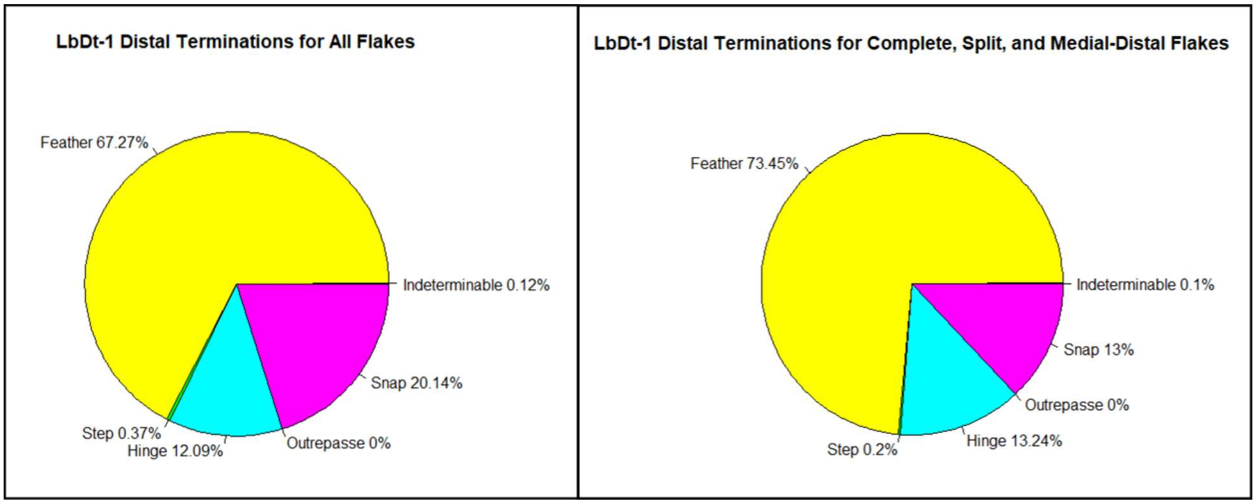


Figure 6.4. Pie charts showing distribution of termination types for the full LbDt-1 flake assemblage (left) and excluding proximal fragments (right).

6.3.3 Conclusions

The attributes that can be affected by post-depositional processes support the same conclusions as the analysis of the technological attributes described in the previous section. The relatively high frequencies of shatter and snap terminations observed at LbDt-1 demonstrate that hard hammer percussion techniques, representing early stage reduction were the primary lithic activity at LbDt-1. The presence of hinge, step, and snap distal terminations along with the high frequency of shatter also suggest that novice stone workers were actively flintknapping at this site (Milne 2005:331; Shelley 1990:191).

6.4 Evidence of Novice Activities at LbDt-1

Novice flintknappers are visible in the archaeological record through the mistakes they made (Cunnar 2015:134; Milne 2005:336; Viken and Darmark 2018:527). Their lack of experience leads to the repetition of certain distinguishable errors including: over or under-estimating the force required to detach a flake (Cotterell and Kamminga 1987:700–701; Milne

2005:331), insufficient platform preparation (Shelley 1990:191–192), striking the objective piece from the wrong angle (Bamforth and Finlay 2008:8); not knowing how to evaluate raw material quality, or which flakes are appropriate for further reduction (Milne 2005:334; Shelley 1990:191).

6.4.1 Stacked Platform Battering

Stacked platform battering is the clearest evidence for novice flintknapping activities as it indicates repeated errors (Goldstein 2019:687). Novices with limited understanding of flintknapping repeatedly strike the same spot believing that more force is needed to detach a flake (Milne 2012:124; Shelley 1990:188). These repeated blows result in stacked battering, which occurs below flake and core platforms, and appears as a series of cascading snap terminations. Expert flintknappers do not make this mistake as they know the appropriate force for flake detachment and recognize the need to adjust the platform angle or prepare the platform to ensure the successful detachment of a flake (Bamforth and Finlay 2008:8; Cotterell and Kamminga 1987:698).

Platform battering was observed on cores and flakes collected at LbDt-1 (Figure 6.5). While platform battering was only noted on 3.5% of flakes (n=114) at LbDt-1, it was recorded on 55% of the cores collected at the site. The low frequency of battering on flakes at LbDt-1 may be a by-product of the collection, relating to the high percentages of shatter (31.68%) and medial-distal flake fragments (36.64%) present in the assemblage, as platform battering cannot be identified on debitage that lacks platforms. The low frequency of platform battering on flakes may also reflect the site function of LbDt-1. As a special use site focused on testing and preparing chert for transportation, lower frequencies of platform battering are expected than at sites where middle and later stages of tool production were carried out. Platform battering is more likely to occur during tool production when certain portions of the objective piece must be removed to achieve the desired tool shape, but this is less important when raw material is simply being tested and reduced for transportation at a quarry like LbDt-1. The difference between the number of flakes with battering and the number of battered cores may reflect that cores suitable for further reduction were removed from the quarry to be reduced elsewhere. Cores that could not be salvaged were abandoned at the site, inflating the number of battered cores compared to those without this attribute at this site (Beck et al. 2002:485; Milne 2005:335).

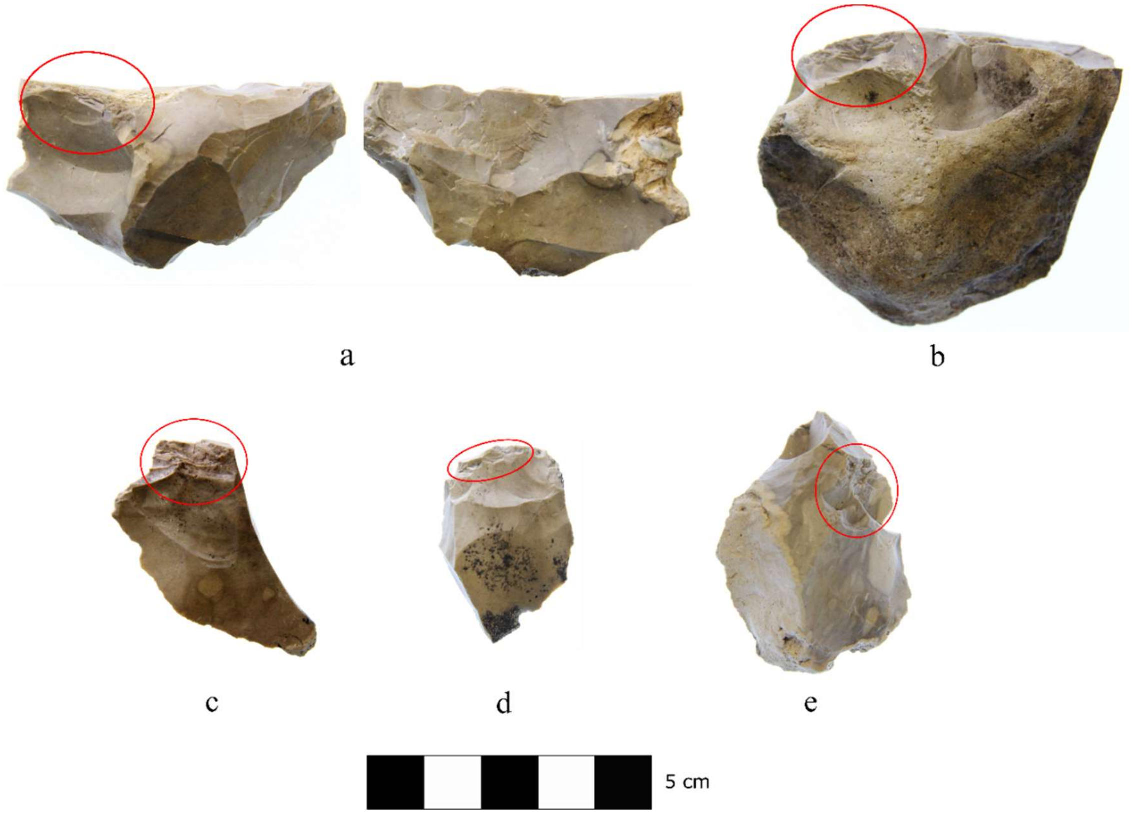


Figure 6.5. Cores (a, b) and flakes (c, d, e) with stacked battering (circled in red).

6.4.2 Evidence of Inappropriate Force

Novices are known to use both too much and too little force in flake detachment. The attributes that relate to excessive force include large bulbs of percussion, pronounced compression rings, eraillure scars, snap terminations, crushed platforms, split flakes, and high frequencies of shatter (Figure 6.6) (Milne 2005:334, 2012:125; Shelley 1990:189–191). While experts can control the development of large bulbs through platform preparation, or by increasing the angle of the striking platform (Dibble 1997:157), novices are less likely to know how to do this. An undesirable result of large bulbs and eraillure scars is that they remove extra material, which exhausts a core prematurely (Dibble 1997:157–158). Characteristics that occur when too little force is applied to the objective piece are hinge and step terminations (Figure 6.6 d, e) (Cotterell and Kamminga 1979:105; Milne 2005:331, 2012:125). These termination types are problematic as they create deep scars on the objective piece that prevent the successful removal of subsequent flakes. (Cotterell and Kamminga 1987:701; Goldstein 2019:690; Shelley 1990:189).

Figure 6.6. Examples of flakes with attributes indicative of inappropriate force including: pronounced compression rings (a, b, f), pronounced bulbs of percussion (c, e), hinge terminations (d, e) and eraillure scars (d, e, f).

Attributes representing excessive force are common among flakes and cores in the LbDt-1 assemblage, and several are often observed together on a single specimen (Table 6.5, Figure 6.6). Attributes that indicate excessive force including bulbs of percussion, compression rings, eraillure scars, snap terminations and crushed platforms are so common at LbDt-1 that they are absent on only 8.97% (n=290) of the flake assemblage. If flakes with characteristics of too little force (hinge and step terminations), are combined with flakes that have characteristics of excessive force, the portion of the assemblage with no attributes relating to inappropriate force decreases to 7.7% (n=249).

Table 6.5. Co-occurring variables indicative of excessive force recorded on flakes. Percentages represent portion of full flake assemblage.

Attribute	Bulb of Percussion	Eraillure Scar	Compression Rings	Crushed Platform	Snap Termination
Bulb of Percussion	35.66% (n=1153)	7.79% (n=252)	25.33% (n=819)	5.47% (n=177)	7.27% (n=235)
Eraillure Scar		11.75% (n=380)	8.6% (n=278)	1.42% (n=46)	2.85% (n=92)
Compression Rings			75.84% (n=2452)	8.2% (n=265)	13.15% (n=425)
Crushed Platform				10.05% (n=325)	1.98% (n=64)
Snap Termination					20.14% (n=651)

6.4.3 Other Attributes Associated with Novice Flintknapping

Three unusual features were noted on flakes and cores collected from LbDt-1 that are thought to be associated with novice flintknapping. The first is the presence of a cone that occurs below or encompassing the platform on the ventral surface of flakes (n=12), and on cores and core fragments (n=7) (Figure 6.7 a, b, d). Viken and Darmark (2018:532) have noted that these cones are formed when a core is battered prior to flake detachment, creating invisible fractures that collapse. This is consistent with observations of these attributes at LbDt-1. Six of the seven cores that were observed to have these cone features also exhibit stacked platform battering. At LbDt-1, these cones are most common on cores that were struck too far into the body of the objective piece (i.e., away from the edge). This has also been noted as a novice error, indicating a lack of flintknapping knowledge or co-ordination (Viken and Darmark 2018:530–532).

The second unusual attribute is associated with the flakes described as “round-bodied”, where the whole ventral surface of the flake appears to be a bulb of percussion (Figure 6.7 e). This attribute was recorded on 36 flakes at LbDt-1. As noted previously, bulbs of percussion are especially pronounced when flakes are detached using more force than is necessary, which is common among novice flintknappers (Milne 2005:334; Shelley 1990:189–191). Therefore, these flakes were likely produced by inexperienced flintknappers using excessive force in flake detachment.

Lastly, flakes with multiple bulbs of percussion were observed in the LbDt-1 assemblage (Figure 6.7 c). Multiple bulbs of percussion have been noted by previous researchers as evidence of novice flintknapping skill (Goldstein 2019:690). This makes sense because novices often fail to prepare and isolate a platform, an important step in the lithic reduction process that allows flintknappers to control the size and shape of the resulting bulb (Dibble 1997:157). This characteristic was recorded on four flakes at LbDt-1, three flakes were observed to have multiple platforms, and three flakes have both multiple bulbs and multiple platforms. The platform modification types observed on these flakes support the idea that these attributes result from neglecting to prepare platforms; four were observed to have crushed platforms, while the remaining six were minimally modified. Alternatively, it is possible that these multiple platform flakes indicate that the indenter used to strike the objective piece was too large for the size of the item being reduced. This could result in too much surface area of the objective piece connecting with the indenter creating platforms at multiple points of impact in a single blow, developing multiple bulbs. Alternatively, it could be related to the use of a soft hammer that became irregular during use. If the flintknapper was inexperienced they may have failed to maintain the hammer and these irregularities could impact the objective piece in multiple places resulting in formation of more than one platform or bulb (Perdaen and Noens 2011:169). Interestingly, one of these multiple platform flakes also has a cone feature.

These unusual attributes indicate a lack of skill, experience, and possibly hand-eye co-ordination on behalf of the flintknapper. These features along with the high frequency of pronounced bulbs of percussion, compression rings, shatter, and snap and hinge terminations recorded on flakes, and their presence in negative flake scars on cores, supports an interpretation that novices were actively involved in flintknapping at this location.

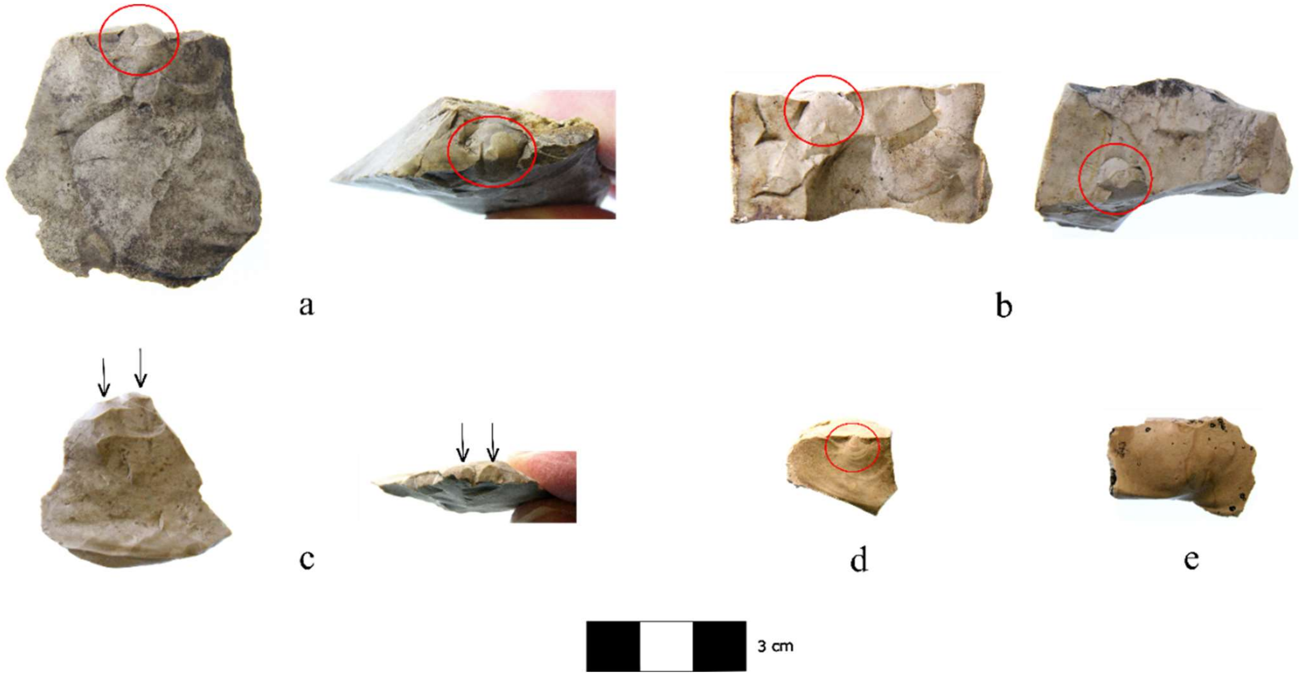


Figure 6.7. Artifacts with cone at platform (circled in red, a, b, d), flake with multiple platforms (arrows indicate platforms) (c), and a round-bodied flake (e).

6.5 Comparison of Upper and Lower Components

Previous researchers divided LbDt-1 into upper and lower components to separate the site into two areas for ease of discussion (Landry et al. 2019). The upper component is the upper terrace of the Hone River, and the lower component is the riverbank itself. This division does not necessarily relate to different occupations of the site or different time periods. Previous researchers have suggested that because the debitage deposit on the upper component is much larger than that on the lower component, chert was likely transported from the lower to the upper component for reduction (Landry et al. 2019). A comparison of these components in terms of lithic technology, reduction strategy, and flintknapper skill level is detailed below.

6.5.1 Completeness on the Upper and Lower Components

Completeness was compared between the two components to determine if there were differences in the intensity of lithic reduction. Overall, the debitage assemblages of the upper and lower components are similar, but the upper component has higher percentages of shatter, medial-distal, and proximal flakes than the lower component, and the lower component has proportionately more complete flakes (Figure 6.8). The percentages of each debitage completeness state are not vastly different between the two components, but chi-squared tests demonstrate that the differences are statistically significant (p-value = 4.243^{-6}). Sullivan and Rozen (1985:773) have argued that high rates of shatter in combination with a large number of complete flakes indicate core reduction, and that tool manufacturing results in high frequencies of broken flakes. This further supports Landry et al.'s (2019) interpretation of the site discussed earlier. The higher concentration of broken flakes in the upper component supports the argument that more intensive reduction occurred there, and that raw material testing and core decortication may have occurred on the lower component where the larger proportion of complete flakes are located (Landry et al. 2019).

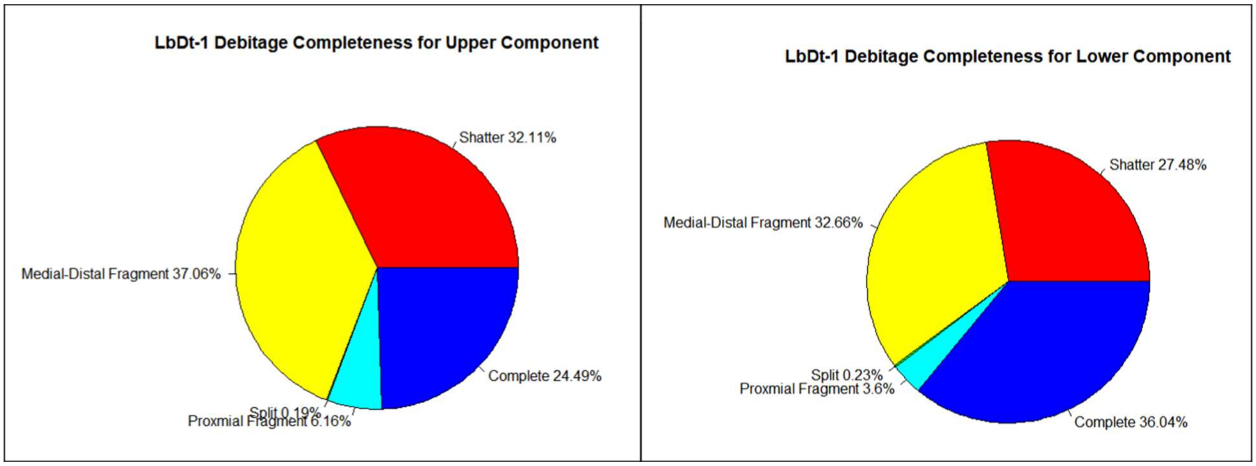


Figure 6.8. Debitage completeness for each component of LbDt-1.

6.5.2 Differences in Debitage Weight and Size Grade Between Components

Weight and size grade were also compared between the two components. If raw material testing was more common on the lower component, and core reduction was the primary activity on the upper component, this should be reflected through the presence of larger, heavier flakes on the lower component and smaller, lighter flakes on the upper component. The results of this comparison further support the interpretation that more intensive reduction occurred at the upper component and raw material testing and decortication occurred at the lower component. The debitage collected from the lower component is on average heavier than that from the upper component (Table 6.6). This is consistent with the size grade distribution for each component, as the lower component also has higher frequencies of debitage in the medium to large size grades (i.e., size grades 3 to 6, Figure 6.9).

Table 6.6. Summary statistics for debitage weight by component.

Summary Statistics	Upper Component	Lower Component
Mean	2.380935	6.001374
Median	0.44	1.75
Range	110.05	64.51
Standard Deviation	5.96626	10.33577
Pearson's Chi-Squared Test	X-squared = 1769.2, df = 973, p-value < 2.2^{-16}	
Levene's Test for Homogeneity of Variance (center = median)	Degrees of Freedom = 1, F-Value = 109.66, PR(>F) = 2.2^{-16}	

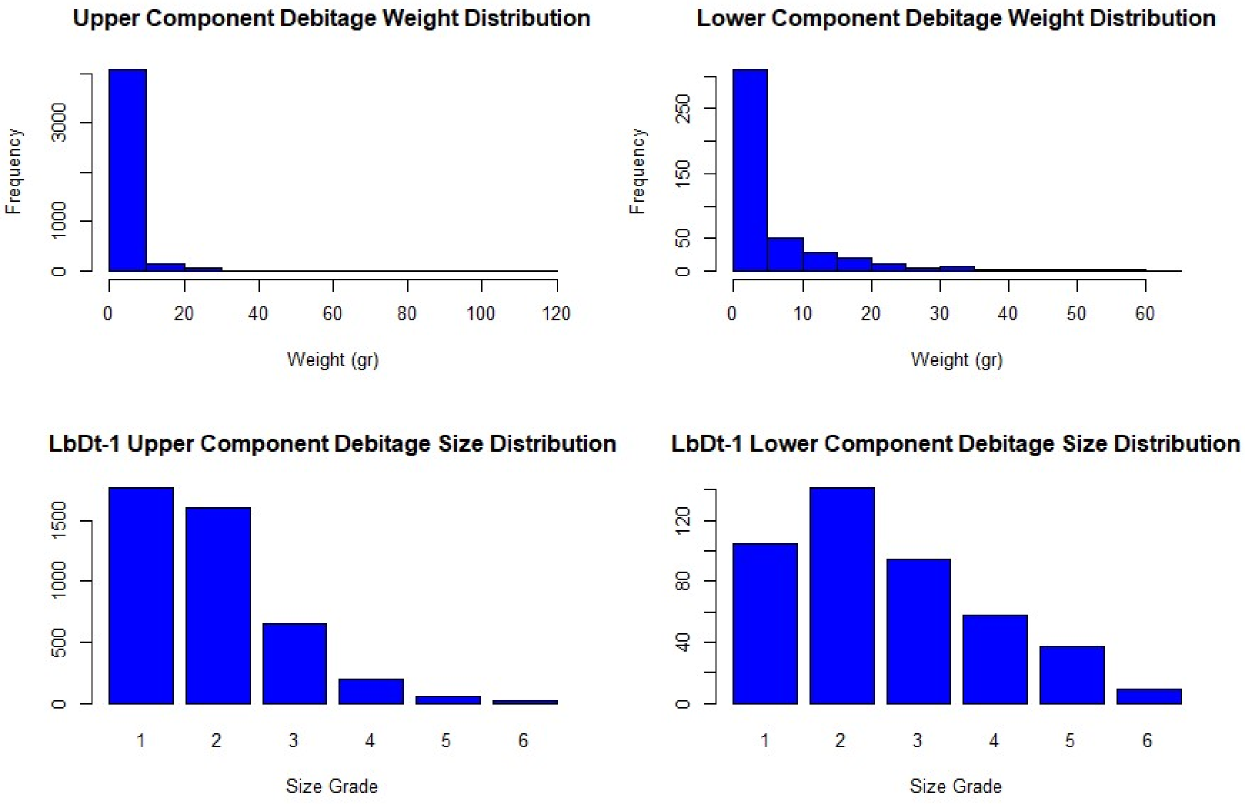
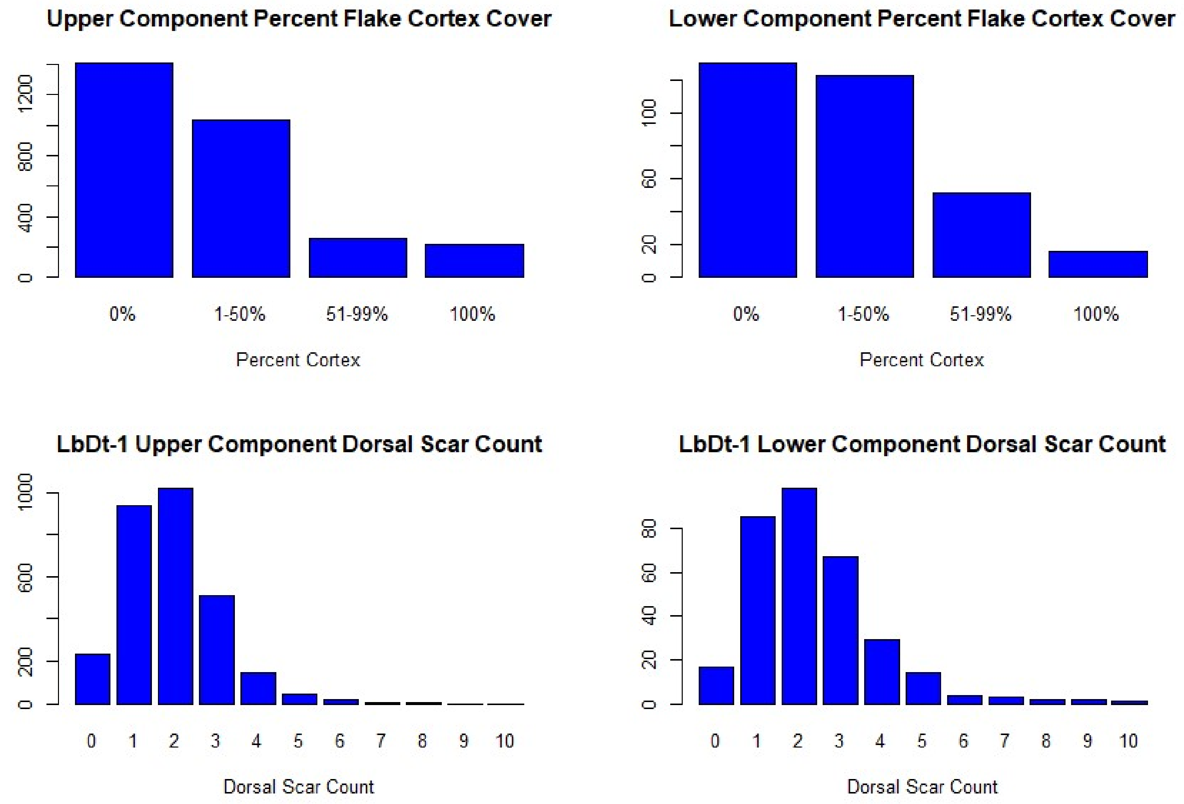


Figure 6.9. Comparison of debitage weight and size grade by component.

6.5.3 Comparison of Cortex and Doral Scar Count by Component

To further investigate differences in reduction stage between the two components, dorsal cortex and dorsal scar counts were compared. If the assumption that initial material testing and reduction occurred on the lower component is correct, higher percentages of cortex are expected on specimens from this area. Furthermore, if reduction was continued on the upper component then greater numbers of dorsal scars should be present on specimens from that location.

The amount of dorsal cortex is significantly different between the two components (chi-squared p-value = 3.836^{-5}, Figure 6.10). The upper component has a higher frequency of flakes with 0% cortex, and a slightly higher frequency of flakes with 100% cortex than the lower component. Although the higher frequency of flakes with 100% cortex on the upper component indicates that some primary reduction occurred there, the lower component has significantly more flakes with 1 to 99% cortex. This is consistent with the idea that this area represents raw material testing and the earliest stages of lithic reduction. However, dorsal scar counts do not support this idea. Dorsal scar counts differ significantly with component (chi-squared p-value = 1.425^{-10}). The upper component has a higher frequency of flakes with zero to two dorsal scars, while flakes with dorsal scar counts between three and seven are more frequent on the lower component (Figure 6.10). This is the opposite of what would be expected if the upper component represented later stage or more intensive lithic reduction than the lower component.


Upper Component Percent Flake Cortex Cover

Lower Component Percent Flake Cortex Cover

LbDt-1 Upper Component Dorsal Scar Count

LbDt-1 Lower Component Dorsal Scar Count

Figure 6.10. Comparison of cortex and dorsal scar counts by component.

6.5.4 Platform Modification at Each Component

Differences in lithic reduction stage and technology between the two components at LbDt-1 should be apparent through platform modification types; however, these attributes were found to be very similar between the two components. Early stage lithic reduction is represented by unmodified, crushed, and minimally modified platforms, these occur in nearly equal frequencies between the two components. Likewise, moderate and advanced platform modifications representing later stages of reduction were also present in similar frequencies. The application of a chi-squared test found that there is no significant relationship between platform modification and component (p-value = 0.4203). There are slightly larger proportions of minimally modified and advance platforms present on the lower component, and slightly more crushed, unmodified, and moderately modified platforms observed on the upper component (Figure 6.11). The higher percentage of advance platforms on the lower component is unexpected, but probably not significant. When combined, advance platforms constitute only 1.33% of platform-bearing flakes in the LbDt-1 assemblage, and as noted previously, do not necessarily represent late stage reduction. Overall, platform modification supports an interpretation that the assemblages from both components represent early stage lithic reduction created using hard percussors and heavy force loads, and that tool production is entirely absent.

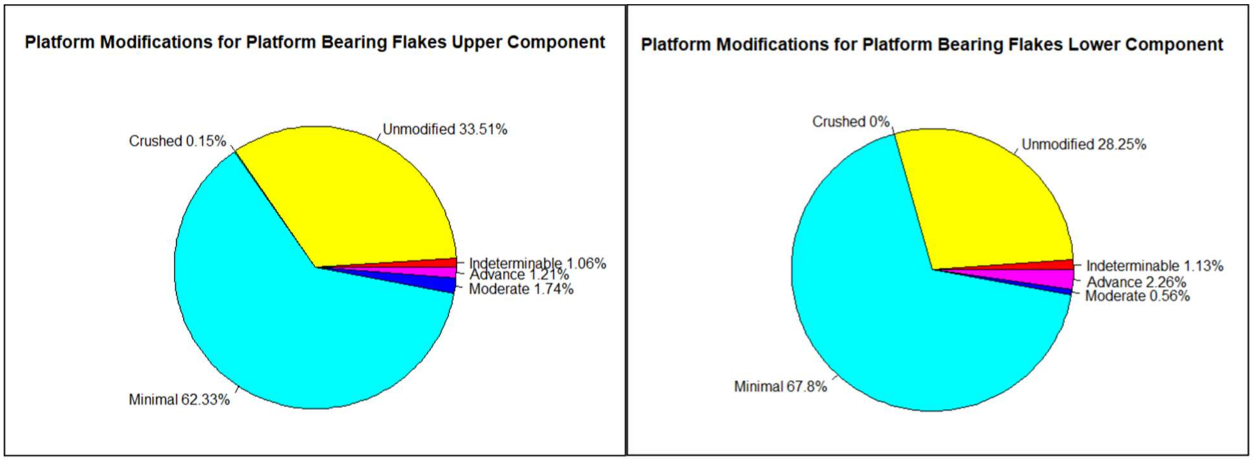


Figure 6.11. Platform modification for platform bearing flakes for each component.

6.5.5 Tools and Cores

Few tools were collected from LbDt-1, resulting in a flake-to-tool ratio of 1616:1. Tools used to calculate this ratio were limited to scrapers as they are the only tool type recovered from LbDt-1 that was extensively retouched. The blade-like flakes, microblades, burin spalls, cores, retouched informal tools, utilized and possibly utilized flakes were excluded as the production of these tools does not result in additional debitage. The inclusion of utilized flakes with debitage was not intended to diminish the importance of informal tools, rather it was done to include more specimens in the flake count, as debitage is the focus of this thesis. The dense nature of the debitage deposit and the gravelly substrate comprising the matrix may have led to attrition on the edges of flakes making them appear utilized. Without microscopic investigation these flakes cannot be confidently identified as utilized. Therefore, this categorization of utilized flakes as debitage also aimed to avoid inflating the tool count with “possibly utilized” flakes that were not investigated in enough detail to confirm if they were in fact utilized. Because there are so few tools in the assemblage, no statistical analysis was applied.

The tools collected at LbDt-1 include seven burin spalls, two end scrapers, ten blade-like flakes, two microblades, two informal tools, two possible microblade cores, and 38 cores and core fragments. Although no burins were recovered at LbDt-1, their use can be inferred by the presence of the burin spalls. Burins are thought to have been used for working hard organic materials such as bone, antler, and ivory (Park et al. 2017:64; see also Barton et al. 1996 for alternative interpretations). Activities involving working hard organic materials are thought to be associated with the warm season (Maxwell 1976:74–75).

Tool use at LbDt-1 appears to have been more common at the upper component, as more tools were recovered from this area than at the lower component (Table 6.7). Cores are the most common tool type found at LbDt-1 making up 44.45% of the tool assemblage for the upper component, and 81.48% of tools on the lower component (Table 6.7). Interestingly, 59% (n=13) of the cores collected from the lower component have attributes associated with novice errors, compared to 37.5% (n=6) of cores at the upper component. The high frequency of cores at LbDt-

1 and the low number of other tool types further supports the interpretation that activities at this site, regardless of component were primarily focused on early stage lithic reduction.

Table 6.7. Number and types of tools collected from each component. Percentages represent portion of tools from that component.

Tool Type	Upper Component	Lower Component
Cores	27.78% (n=10)	33.33% (n=9)
Cores with Novice Attributes	16.67% (n=6)	48.15% (n=13)
Blade-Like Flakes	25% (n=9)	3.7% (n=1)
Microblades	2.78% (n=1)	3.7% (n=1)
Microblade Cores	5.56% (n=2)	0
Burin Spalls	13.89% (n=5)	7.41% (n=2)
End Scrapers	5.56% (n=2)	0
Informal Tools	2.78% (n=1)	3.7% (n=1) (novice)
Sum of Tools	36	27

6.5.6 Skill Level and Component

A comparison of attributes that are indicative of lower levels of flintknapping skill, demonstrates that these characteristics are more common on flakes and cores collected from the lower component. Stacked platform battering and eraillure scars occur more frequently on flakes from this component, and chi-squared tests indicate that these attributes are dependant on the component (p-values = 6.371^{-6} and 0.0001658 respectively). Bulbs of percussion and compression rings are also more common on the lower component, but this is not statistically significant (chi-squared p-values = 0.1527 and 1 respectively). On the lower component cores with novice attributes including platform battering and negative flake scars with hinge and snap terminations outnumber cores where these characteristics are absent. However, flakes with novice distal termination types including hinge, step, and snap are most common on the upper component, while feather terminations are more frequent on the lower component (Figure 6.12). This difference is statistically significant as chi-squared tests demonstrate that distal termination type is dependant on component (p-value = 0.01703). Although there is evidence for novice flintknapping at both components, the most compelling evidence is found on flakes and cores with stacked platform battering, and negative flake scars on cores with hinge and snap terminations, all of which are most common on the lower component where the main activities revolve around testing raw chert nodules.

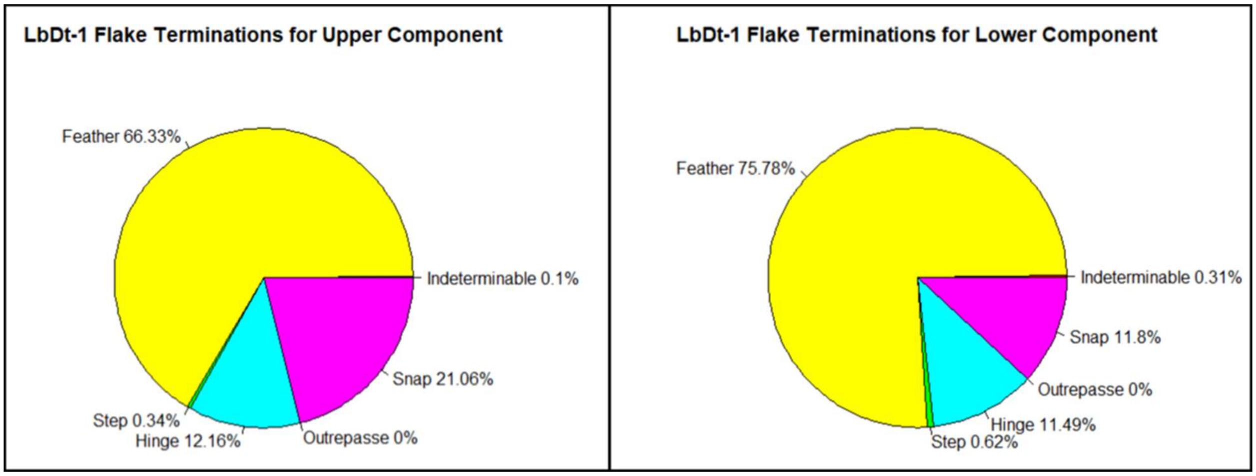


Figure 6.12. Comparison of all flake termination states between the upper and lower components.

6.5.7 Conclusions

In general, the comparison of the upper and lower components of LbDt-1 supports Landry et al.'s (2019) inference that chert was tested on the lower component and was transported to the upper component for further reduction. Both component assemblages were found to represent early stage reduction using hard hammer techniques, but it seems that tool use was more common at the upper component. Although novices were actively involved in flintknapping at both components of LbDt-1, their activities are most visible on the lower component.

The higher incidence of flakes and cores with novice attributes present on the lower component could relate to how Palaeo-Inuit lithic apprenticeships were staged. The youngest novices may have practiced breaking rocks and learning how to judge raw material quality on the lower component where chert is found outcropping from the limestone bedrock, while novices in later stages of their apprenticeship worked more closely with experts on the upper component learning early stage reduction techniques. One possible explanation for the greater frequency of tools on the upper component is that tools found at this site were made by experts to demonstrate specific steps in tool making or were made by more advanced novices who were practicing specific flintknapping techniques such as pressure flaking. A use-wear study could confirm if these tools were actually used, or if they were merely educational aids, but that is beyond the scope of this project.

6.6 Conclusions

Overall, the debitage assemblage from LbDt-1 represents early stage lithic reduction of small, locally available, poor-quality chert nodules using hard percussors and heavy force loads, this is also true of the assemblage from each component. However differences in terms of size grades, weight, cortex, and completeness between the components supports the inference made by Landry et al. (2019) that material was tested on the lower component and brought to the upper component for further reduction.

Evidence from the debitage indicates that tools were not produced on the site, but of the few tools in the LbDt-1 assemblage, most were collected from the upper component. These tools may have functioned as teaching aids for the instruction of novices who were at a more advanced stage in their lithic apprenticeship than those who were training on the lower component. Cores were the dominant tool, which is consistent with the narrative of this site primarily functioning as a chert source. The other tools represent a range of activities including sewing and working hard organic materials. These tasks are associated with the warm season, therefore, their presence further confirms that was the season of occupation for LbDt-1 (Maxwell 1976:74–75). This seasonal occupation is consistent with previous interpretations of when Palaeo-Inuit peoples scheduled trips to the interior (Bielawski 1988:56; Milne and Park 2016:696). The presence of burin spalls at this site indicates that it was used by Pre-Dorset peoples, although it was likely also used by their Dorset descendants who are also known to have made seasonal trips to the interior and also relied on chert to manufacture their toolkits (Landry 2013; Milne et al. 2012).

There is evidence for novice participation in flintknapping activities at both components, but their mistakes are most visible at the lower component. There is little evidence of experts correcting novice errors at LbDt-1. This apparent lack of supervision, along with the high frequencies of large pieces of shatter and the discard of cores with remaining utility, suggests that novices at LbDt-1 were allowed to experiment and practice flintknapping without concern for material conservation. The following chapter investigates whether this permissiveness of novice use of chert at LbDt-1 differs from sites where chert is less abundant. These inter-site comparisons will provide the background information necessary for further discussion of the social significance of quarries, like LbDt-1, to Palaeo-Inuit peoples on southern Baffin Island.

7. Regional Comparisons with Inland and Coastal Palaeo-Inuit Sites

Chapter 6 described the results of the LbDt-1 debitage analysis. This chapter places those findings within the established patterns of Palaeo-Inuit technological organization, mobility, and flintknapping apprenticeship on southern Baffin Island. This chapter begins by describing these established patterns. Descriptions of the assemblages used for comparison with LbDt-1 follow, organized by region. Four sites (Mosquito Ridge [MaDv-11], Sandy Point [LlDv-10], Tungatsivvik [KkDo-3], and Shaymark [KkDn-2]) were selected for comparison with LbDt-1 because they have been central to earlier interpretations of regional patterns in the lithic reduction continuum and, in particular, the identification and interpretation of novice flintknapping activities (see Milne 2003a). Like LbDt-1, these four sites were occupied by Palaeo-Inuit peoples. The same methods of debitage analysis used in my research were applied in the initial study of these four sites (Milne 1999, 2003a) thus making the results directly comparable.

7.1 Established Patterns of Technological Organization, and Lithic Apprenticeship on Southern Baffin Island

Palaeo-Inuit mobility on southern Baffin Island is characterized by seasonal movements between the coast and the interior. These movements supported a dual subsistence economy where seasonal rounds were scheduled to take advantage of resources as they became available (Landry et al. 2020; Landry 2013:77; Milne et al. 2012:280, 2013:55). The Palaeo-Inuit social structure was flexible, making it possible for a group to split into task-specific subgroups during the warm season who could focus on procuring different resources from disparate regions simultaneously (Milne 2003a:300–301, 2005:340). Seasonal partitioning of the larger group was essential because although subsistence resources in the coastal uplands were sufficient to support small groups of Palaeo-Inuit peoples year-round, the absence of good-quality chert on the coast necessitated long-distance travel to the interior during the warm season (Milne 2005:340, 2008:193, 2012:128).

Several lines of complementary evidence have been used to connect early and middle stage lithic reduction events in the interior to late stage reduction episodes observed on the coast. Debitage analysis of sites in each of these regions concluded that chert was procured at inland source locations during the warm season when nodules could be easily collected from gravel deposits on the surface or extracted from limestone outcrops (ten Bruggencate et al. 2015:192, 2017:652; Milne 2003a). This chert was then tested and minimally reduced into preforms or cores at interior sites to facilitate its transport to coastal locations (Landry et al. 2020; Milne 2003a:280, 282). Lithic activities that followed at coastal sites complemented those of the interior, and focused on late stage tool production, maintenance, and some tool liquidation or recycling (Milne 2012:132).

Geochemical analyses support this interregional lithic reduction pattern. They demonstrate that chert from at least two known quarries located in the interior (LbDt-1 and LdDx-2) can be found at deep interior habitation sites (LdFa-12, 13, and LeDx-42). Chert from these quarries is also present at coastal sites including Tungatsivvik (KkDo-3) and Crystal II (KkDn-1). This provides direct evidence that chert from these source locations was transported across vast distances on southern Baffin Island (ten Bruggencate et al. 2017:659; Landry et al. 2020).

The local geology of southern Baffin Island is such that LbDt-1 would have been an important chert outcrop for people travelling between the south coast and the interior (Landry et al. 2020:159). LbDt-1 was used regularly over millennia for intensive lithic reduction. This is evidenced by geophysical investigations using ground penetrating radar and electromagnetic imaging that demonstrated the debitage deposit at this site is expansive and deep, and its placement on the underlying bedrock is entirely anthropogenic (Landry et al. 2020, 2019). Clearly, LbDt-1 was an important destination for Palaeo-Inuit people as they traversed the intermediate zone travelling from the south coast to the deep interior or vise versa (Landry et al. 2020:159).

In terms of novice flintknapping, previous studies have found that novice activities on southern Baffin Island are localized to sites in the interior region (Milne 2003a, 2005, 2012). However, at the time that these studies were published, no chert quarries were known on southern Baffin Island, and it was unknown to what extent novices were involved in chert procurement at these special use sites. LbDt-1 provides an essential site to anchor regional lithic reduction sequences since it is a source area. Having identified this site, we can now consider how raw material procurement and the social significance of quarries play a central role in novice flintknapping activities and the transmission of knowledge from expert to novice.

7.2 Assemblage Data

Four previously studied Pre-Dorset sites on southern Baffin Island were compared with LbDt-1. This section provides brief descriptions of the lithic assemblages from each site. Two sites are located in the interior region, Sandy Point (LlDv-10) and Mosquito Ridge (MaDv-11), and two sites, Tungatsivvik (KkDo-3) and Shaymark (KkDn-2), are located on the south coast at the head of Frobisher Bay.

7.2.1 The Interior Sites

Mosquito Ridge (MaDv-11) and Sandy Point (LlDv-10) were both occupied in the warm season and are located on Burwash Bay at the south end of Nettilling Lake (Milne 2005:339). The raw materials in each assemblage are homogenous, comprising mainly poor-quality local chert (Milne 2003a:218, 235). Debitage analyses of these assemblages determined that both were created using a single reduction strategy focused on early and middle stage reduction. This interpretation is based on the unimodal distributions of size grade, weight, and dorsal scar count documented at each site (Milne 2003a:218, 2005:340–341; Milne and Donnelly 2004:103).

A difference between the interior sites is that Sandy Point has a high frequency of cortex retention. Thirty-five percent of the assemblage retained cortex across all size grades indicating that small nodules of locally available chert were being reduced (Bradbury and Franklin 2000:50; Milne 2003a:217–218, 2005:340). Mosquito Ridge has comparatively little cortex retention, represented on only 15% of specimens. This is lower than expected considering its very large assemblage size (n=15,628). One explanation for the low incidence of cortex at Mosquito Ridge is that material was brought to the site in a reduced state (Milne and Donnelly 2004:103).

At both Sandy Point and Mosquito Ridge, there is a high percentage of platform-bearing flakes (68% [n=741] and 60% [n=9530], respectively), most of which are minimally modified. Minimally modified platforms are associated with early stage reduction and also low skill. Sandy Point represents the earlier stage in the reduction continuum, where local chert nodules were tested and minimally modified into early stage cores along with limited production of tool blanks and preforms (Milne 2005:340, 2008:190). The Mosquito Ridge assemblage corresponds with the next step in the reduction continuum, where the focus was on the early and middle stages of lithic reduction to reduce cores and produce tool preforms. These were then transported to be completed at other locations (Milne 2008:190).

Poorly made tools and debitage with attributes representing inappropriate force loads are evidence of novice participation in flintknapping present in the assemblages from both sites (Milne 2005:333–334). However, there were fewer specimens with novice attributes identified at Mosquito Ridge. This suggests that novice activities were more restricted at Mosquito Ridge than they were at Sandy Point (Milne 2003a:281, 2005:341). This difference in novice participation may be explained through the value that was attached to the chert at Mosquito Ridge. Because chert was transported to this location in a reduced form, time and energy had already been invested in it, increasing its value. In contrast, chert at Sandy Point is readily available as raw nodules, therefore, novice mistakes at this location would be less costly to the group making it a more appropriate location for novices to practice the craft (Ferguson 2008:54; Milne 2003a:281).

7.2.2 The Coastal Sites

Shaymark (KkDn-2) and Tungatsivvik (KkDo-3) are thought to have been occupied at the start and end of the warm season, and are located in the coastal uplands at the head of Frobisher Bay (Milne 2003a:273, 276–278). Like the interior sites, both coastal assemblages are dominated by chert, but with little cortex retention. Both the Shaymark and Tungatsivvik assemblages have unimodal distributions for size grade and weight. However, they differ in dorsal scar count. The Shaymark assemblage has a unimodal distribution for dorsal scar count, while the dorsal scar count is bimodal for the Tungatsivvik assemblage. When these four attributes are considered together they demonstrate that the Shaymark assemblage was produced using a single reduction strategy focused on late stage tool reduction and maintenance (Milne

2003a:155, 2012:129). The bimodal distribution for dorsal scar count in the Tungatsivvik assemblage resulted from the use of two reduction strategies, including late stage tool reduction and maintenance, and production of expedient tools using bipolar techniques (Milne 2012:129). Bipolar techniques would have been used to make use of the small, locally available chert pebbles or for tool liquidation. There is no evidence for novice flintknapping at Shaymark or Tungatsivvik, which is not unexpected given the near absence of workable stone on the coast and the focus on tool maintenance and curation at these sites (Milne 2003a:272, 275, 2012:132–133). Tungatsivvik was occupied during the spring, while special task groups travelled to the interior region. Therefore, novices likely were not present at this site. If they were present, their energies may have been directed to tasks other than flintknapping. Instead, they would have joined the group travelling to the interior where they would have the greatest opportunity to participate in flintknapping activities because access to lithic raw material is less restricted in the interior (Milne 2003a:275). Shaymark was occupied late in the summer or in the early fall and was a location where groups who had travelled inland were reunited with those who remained in the coastal uplands (Milne 2003a:273). Therefore, novices likely were present at Shaymark, as the rest of their social group was gathered there, but there is no evidence for novice flintknapping activities at this site (Milne 2012:132–133). However, activities at this time of the year were focused on shaping organic materials into tools, not making stone tools (Milne 2003a:161). Therefore, instruction of novices may have been directed towards these tasks rather than flintknapping (Milne 2003a:161).

Milne's (2003a) analysis of Sandy Point, Mosquito Ridge, Shaymark, and Tungatsivvik demonstrated a clear divide in lithic activities between the interior and coastal regions of southern Baffin Island. Activities associated with early stage lithic reduction and novice flintknapping were localized to the interior region, while tool finishing and maintenance activities were conducted by experts on the coast.

7.3 Situating LbDt-1 within the Regional Lithic Reduction Continuum

The geological environment of southern Baffin Island makes access to lithic raw material uneven between the interior and the coast. It is likewise uneven between the warm and cold seasons as toolstone could only be collected when the ground was free of snow and ice (Milne 2008:185–186; Milne et al. 2013:56). This restricted access to lithic raw materials was an important driver influencing the seasonal round of Palaeo-Inuit people resulting in scheduled trips to the interior region during the warm season specifically for the purpose of toolstone procurement (Milne 2005:340). The first destination on these trips would have been a quarry site like LbDt-1. Comparisons of debitage attributes (e.g., size grade, weight, cortex, and dorsal scar count) between assemblages from LbDt-1, Sandy Point (LlDv-10), Mosquito Ridge (MaDv-11), Shaymark (KkDn-2), and Tungatsivvik (KkDo-3) support this assertion.

The strongest evidence that LbDt-1 represents the earliest point in the lithic reduction continuum is the aggregated size and weight of its debitage assemblage. LbDt-1 has the second largest mean debitage size following Sandy Point (LlDv-10), and the heaviest mean weight among all sites considered (Table 7.1). The variation in these attributes between sites is statistically significant, and both size grade and weight are dependant on site (chi-squared and Levene's tests for both attributes have p-values of $< 2.2^{-16}$). Material testing and minimal early stage reduction were the main lithic activities at LbDt-1, and this is reflected in the very heavy mean debitage weight. These activities produce greater frequencies of thick flakes and shatter, which are heavier than the middle and late stage flakes present at Sandy Point, Mosquito Ridge, Shaymark, and Tungatsivvik that tend to be small and thin (Ahler 1989a:89). Further indications that LbDt-1 represents the earliest phase of reduction comes from the amount of cortex retention and the mean dorsal scar counts in each assemblage. LbDt-1 has the greatest amount of cortex present and the lowest mean dorsal scar count of all sites in the study (Table 7.1). Cortex and dorsal scar count are dependant on site, are statistically significant, and vary significantly (chi-squared p-value for both attributes is $< 2.2^{-16}$, Levene's test for cortex p-value is $< 2.2^{-16}$, and 5.625^{-8} for dorsal scar count). This combination of attributes demonstrates that LbDt-1 represents an earlier stage in the reduction continuum because as the reduction process proceeds, less cortex remains on the objective piece and more dorsal scars representing earlier flake detachments can be observed on flakes (Ahler 1989a:90; Magne 1989:17). In short, the LbDt-1 assemblage significantly contrasts with the coastal assemblages and Mosquito Ridge (MaDv-11), which are dominated by small, cortex-free flakes with high dorsal scar counts (Table 7.1). The Sandy Point (LlDv-10) assemblage is the only site with comparably low dorsal scar counts and high frequencies of cortex, but these differences are not as pronounced as at LbDt-1.

Of the five sites considered, LbDt-1 and Sandy Point (LlDv-10) represent the procurement stage of the lithic reduction continuum. The difference between them is that chert at Sandy Point was reduced to a later stage than at LbDt-1, as evidenced by the presence of lighter flakes, lower frequencies of shatter, less cortex, and the higher mean dorsal scar count at Sandy Point (LlDv-10). The Sandy Point assemblage indicates that preforms and tool blanks were produced on site (Milne 2005:340). Preform and blank production require greater skill than raw material testing and early stage reduction, and result in higher frequencies of lighter flakes. There is no evidence for these middle stage activities at LbDt-1, where lithic reduction activities were limited to only the earliest phases of reduction.

Table 7.1. Mean size grade, weight, and dorsal scar counts, and percentages of cortex and shatter across sites.

	LbDt-1	LlDv-10	MaDv-11	KkDo-3	KkDn-2
Mean Size Grade	1.96	2.14	1.58	1.74	1.69
Mean Weight (g.)	2.72	0.43	0.18	0.28	0.22
Mean Dorsal Scar Count	2.02	2.10	2.70	2.78	3.08
Percent of Assemblage with Cortex	56.56%	35.48%	15.42%	17.41%	19.76%
Percent of Assemblage that is Shatter	31.68%	6.84%	7.88%	10.02%	6.14%

Once collected from sites like LbDt-1 and Sandy Point (LlDv-10), chert was transported across the landscape throughout the year (Figure 7.1). Minimally reduced chert was transported from the quarry to interior workshop sites such as Mosquito Ridge (MaDv-11) where tool preforms and blanks were produced and exhausted curated tools were discarded (Milne 2003a:281, 2005:334). Later in the warm season (i.e., late summer or early fall), the portion of the social group that travelled inland brought the preforms produced at the interior workshops to coastal habitation sites like Shaymark (KkDn-2) where they were reunited with those who remained in the coastal uplands. With the entire social group present at sites like Shaymark (KkDn-2), the imported preforms were used, and maintained by experts in anticipation of further use throughout the winter (Milne 2003a:273). This late stage reduction is demonstrated statistically at Shaymark (KkDn-2), which has the second smallest mean debitage size grade, and weight, the second least amount of cortex following Mosquito Ridge (MaDv-11), and the lowest flake-to-tool ratio (Table 7.1, Table 7.2). Tools from Shaymark (KkDn-2) were finely worked to a degree that was more than strictly functional (Milne 2003a:159). Expert flintknappers working stone at this site added stylistic flourishes to their tools resulting in the increased production of small flakes. This extra effort is visible in the lithic debitage, as Shaymark (KkDn-2) has the highest mean dorsal scar count of all five sites (Table 7.1). As more small flakes were removed, the dorsal scar count increased, and as noted above, the differences between assemblages are statistically significant.

From sites like Shaymark, finished tools were brought to winter camps on the sea ice or outer coast where they were used and maintained. In the early spring people returned to the coastal uplands, occupying locations like Tungatsivvik (KkDo-3) where tools from winter camps with remaining utility were brought and further maintained by experts (Milne 2003a:275–276). Evidence of this tool curation can be found in the lithic debitage of Tungatsivvik (KkDo-3), which has the greatest variation in raw material type with 4.27% (n=26) of its assemblage being made from material other than Baffin Island chert. Statistically, the differences in raw material types between sites are significant (chi-squared and Levene's test both have p-values of $< 2.2^{-16}$). From sites like Tungatsivvik, the cycle would start over. Most of the community including novice flintknappers would choose to travel inland to procure chert at sites like LbDt-1. Those unable to make the trip (e.g., the infirm, the elderly, pregnant women, those looking after small children, and anyone who simply did not wish to go) would remain in the coastal uplands to hunt and fish using curated toolkits transported from winter camps along with expedient tools made from local chert pebbles using bipolar reduction (Milne 2003a:275). The use of bipolar technology at Tungatsivvik (KkDo-3) is evidenced by the high percentage of shatter and cortex bearing debitage, which are both statistically significant (chi-squared and Levene's test for debitage completeness both have a p-value of $< 2.2^{-16}$), as well as the higher flake-to-tool ratio at Tungatsivvik compared to Shaymark (KkDn-2) (Table 7.2). The people at Tungatsivvik (KkDo-

3) could make do with these tools until the late summer or early fall when those who travelled inland returned with a fresh supply of toolstone (Milne 2003a). Flake-to-tool ratios support the interpretation that tool manufacture was regionally staged with initial production occurring inland, and tool completion, use, maintenance, and recycling taking place on the coast. These ratios show a clear divide in tool production between the two regions with high ratios in the interior indicating that tool utility was being replaced (Ricklis and Cox 1993:450) and notably low ratios on the coast reflecting the limited tool production conducted at these sites (Table 7.2). The dramatically higher flake-to-tool ratios at LbDt-1 and Mosquito Ridge (MaDv-11) demonstrate the massive volume of material that was reduced at these sites and speaks to their position as early stage reduction sites. The lower flake-to-tool ratio at Sandy Point is indicative of its different occupation history. Both LbDt-1 and Mosquito Ridge were frequently reoccupied, while Sandy Point represents a single occupation ephemeral site (Milne 2005:341). This differential use would have affected the amount of debitage produced at each site, and Mosquito Ridge's function as a workshop where preforms were produced resulted in more debitage than at Sandy Point (Milne 2005:340).

Table 7.2. Flake-to-tool ratios by site.

Site	Flake-to-Tool Ratio
LbDt-1	1616:1
Sandy Point (LlDv-10)	14:1
Mosquito Ridge (MaDv-11)	40:1
Tungatsivvik (KkDo-3)	8:1
Shaymark (KkDn-2)	3:1

7.4 Opportunities for Novice Flintknapping

The Palaeo-Inuit seasonal round played an important role in determining when and where novices learned to flintknap (Figure 7.1) (Milne 2012:120, 2014:108). Trips to the interior to procure chert were important milestones for young people engaging in lithic apprenticeships as they provided the first opportunity to gain practical experience in flintknapping (Milne 2003a:275, 2005:341; Milne et al. 2014). A few factors were likely considered when deciding if a young person was ready to begin their lithic apprenticeship. Physical maturity would have been important as novices needed to have the stamina to endure the long trip from the coast to the interior and they needed to have the upper body strength necessary to break rocks (Milne 2012:129, 2014:109). The novice and their family also needed to consider familial responsibilities when deciding if the novice would join a group travelling inland (Goldstein 2019:705).

There are two differing views among archaeologists regarding who participated in making stone tools. One common and outdated view is that flintknapping and stone tool use were the domain of men (Bamforth and Finlay 2008:17; Gero 1991:163; Hayden and Hutchings 1989:238–239). More recent interpretations presume that every person participated in a lithic apprenticeship when they came of age, regardless of sex or gender. Lithic tools were used by all members of the community, and Palaeo-Inuit communities were very small, which would require that everyone have the skills necessary for survival (Gero 1991:170; Milne 2003a:276, 2014:109). It was important that all sexes and genders participated in trips to the interior because they provided young people not only the opportunity to flintknap, but also to learn about their environment and culture (Milne 2014:110). Inland travel also offered an opportunity for groups from dispersed camps to aggregate at lithic workshops to meet potential spouses, exchange news, visit, hunt, and procure chert (Milne 2003a:277, 2008:184, 2014:102). Therefore, it would be maladaptive to prohibit one segment of the population (i.e., female identifying individuals) from participating in these trips (Milne 2003a:277, 2014:109).

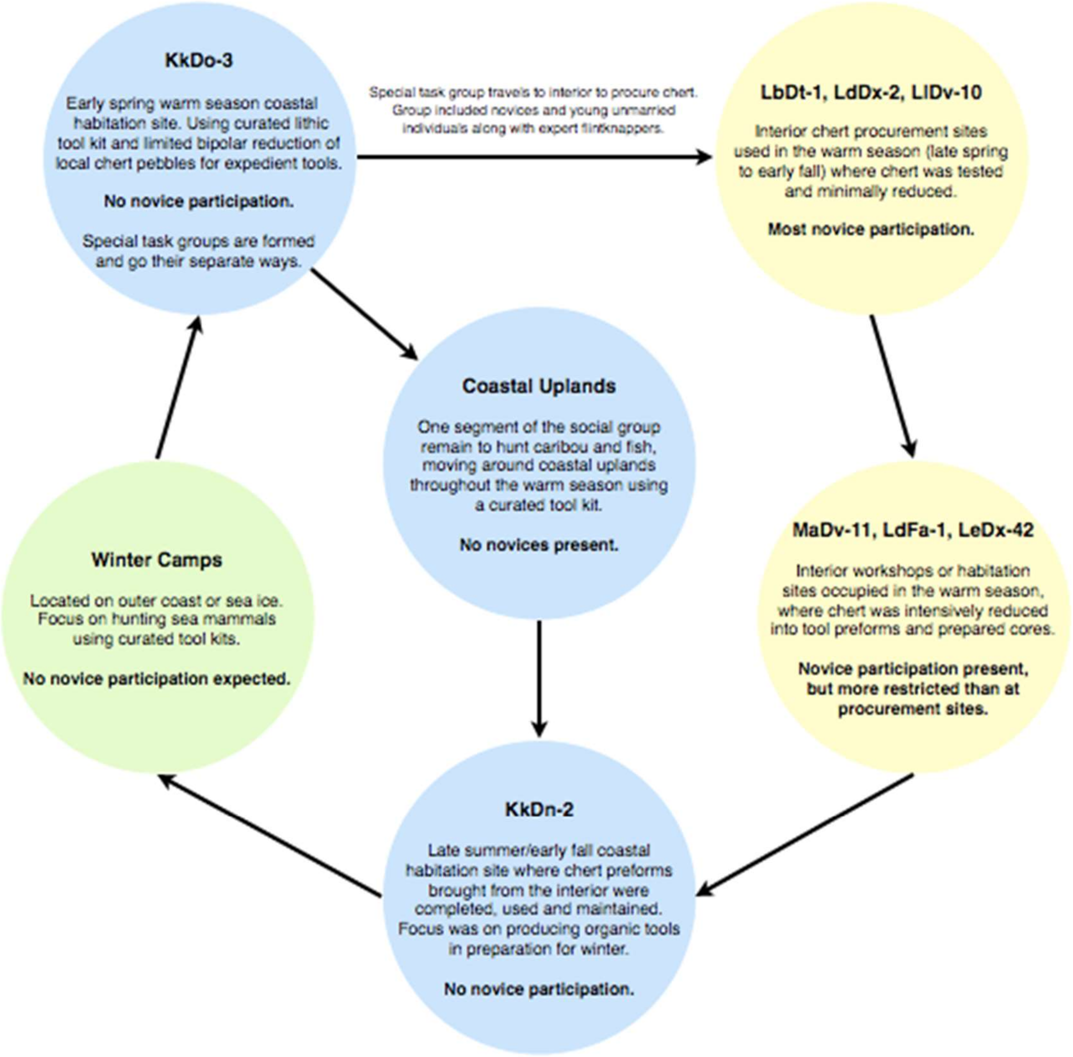
On southern Baffin Island novice flintknapping is directly linked with raw material availability. Therefore, it was restricted both seasonally and spatially – limited to warm season trips to the interior where raw material was most abundant and novice errors did not threaten the group's chert supply (Milne 2003a:281–282, 2005:337, 2012:138). Throughout the rest of the year novices had limited opportunities to engage in flintknapping. Preforms and prepared cores transported from the interior were completed, used, and maintained exclusively by experts at coastal habitation sites where there is no evidence of novice participation in flintknapping (Milne 2003a:273–276, 2014:110).

When comparing the five sites in this study, LbDt-1 has the highest frequency of attributes representing low skill. Flakes attributed to novices represent approximately 56.6% (n=1830) of the LbDt-1 flake assemblage compared to 23.5% at Sandy Point, 3.5% at Mosquito Ridge, and a complete absence at the coastal sites of Shaymark and Tungatsivvik (Milne 2003a:273–275, 2005:334, 2014:110). The greater frequency of novice flintknapping at LbDt-1 is also evidenced by the very high frequency of shatter in its assemblage (31.68%, n=1499) compared to the other sites in the study (Table 7.1). This difference in debitage completeness between sites is statistically significant (chi-squared and Levene's tests p-value for each $< 2.2^{-16}$).

The fact that novice flintknapping activities are most prevalent at LbDt-1 is consistent with previous research on lithic apprenticeship that argues that due to the abundance of raw material at quarries, these are the most likely place for young people to gain experience in flintknapping (Bamforth and Finlay 2008:17; Cunnar 2015:135; Eigeland 2011:136; Goldstein

2019:685). These findings support previous research that suggests that LbDt-1 was a location where novices had their first opportunity to "break rocks" (Milne et al. 2014). In their 2014 presentation, Milne and colleagues proposed that it was young apprentices who were responsible for testing and transporting minimally reduced chert from the LbDt-1 quarry over 100 kilometers to the nearest inland workshop or habitation sites located on the shores of Mingo and Amadjuak Lakes. They argued that the effort expended in transporting minimally modified chert over such long distances would have served to instill an appreciation for the value of this resource (Milne et al. 2014), and perhaps taught novice flintknappers the importance of reducing stone prior to transporting it. The very high frequency of novice attributes at LbDt-1 supports this idea.

Chert was not transported from quarries to inland workshop and habitation sites solely to teach novices the value of lithic raw material. These locations were selected for their locally abundant and easily hunted subsistence resources such as caribou, snow geese, and fish which were not necessarily present at quarries (Landry et al. 2020; Landry 2013:75; Milne and Donnelly 2004:107). The confluence of abundant subsistence and raw material resources at these locations along with the warm weather and friendly environment allowed groups to aggregate in these areas to visit, hunt, and reduce chert imported from the quarry into tool preforms, blanks, and prepared cores in a relaxed atmosphere (Landry 2013:68; Milne 2008:191; Milne et al. 2014). Comparison of these sites indicates that novice activities were staged differently between chert sources and workshops. This suggests that lithic apprenticeships were structured so that novices at the start of their apprenticeship were permitted to freely break rocks at source locations such as LbDt-1 and Sandy Point. Novices were also allowed to flintknap alongside experts at secondary locations (Milne 2003a, 2005, 2014:107); however, their activities may have been more regulated at these sites than at the quarry. It is likely that only older novices in the later stages of their apprenticeship were permitted to practice at workshop and habitation sites, where they would receive formal instruction from experts to minimize novice errors and compensate for the reduced availability of toolstone at these sites compared to source locations (Milne et al. 2014).



KkDo-3

Early spring warm season coastal habitation site. Using curated lithic tool kit and limited bipolar reduction of local chert pebbles for expedient tools.

No novice participation.

Special task groups are formed and go their separate ways.

Special task group travels to interior to procure chert. Group included novices and young unmarried individuals along with expert flintknappers.

LbDt-1, LdDx-2, LlDv-10

Interior chert procurement sites used in the warm season (late spring to early fall) where chert was tested and minimally reduced.

Most novice participation.

Coastal Uplands

One segment of the social group remain to hunt caribou and fish, moving around coastal uplands throughout the warm season using a curated tool kit.

No novices present.

MaDv-11, LdFa-1, LeDx-42

Interior workshops or habitation sites occupied in the warm season, where chert was intensively reduced into tool preforms and prepared cores.

Novice participation present, but more restricted than at procurement sites.

Winter Camps

Located on outer coast or sea ice. Focus on hunting sea mammals using curated tool kits.

No novice participation expected.

KkDn-2

Late summer/early fall coastal habitation site where chert preforms brought from the interior were completed, used and maintained. Focus was on producing organic tools in preparation for winter.

No novice participation.

Figure 7.1. Cycle of chert movement and lithic reduction on southern Baffin Island.

7.5 Conclusions

As a quarry, LbDt-1 represents the first stage in the lithic reduction continuum as the place where raw chert was procured. The absence of evidence for tool production at LbDt-1 and the lack of discarded curated tools is unusual for a quarry. When quarries are located at a significant distance from habitation sites (15 kilometers or more), the field processing model predicts that intensive early to middle stage reduction will occur at the quarry in order to optimize the transport of useable material (Beck et al. 2002:492; Shott 2015:552). Typically, this retooling behaviour also results in the discard of curated tools at quarry sites (Andrefsky 1994:23). However, only minimal lithic reduction occurred at LbDt-1 despite it being over 100 kilometers away from the closest recorded habitation site (Landry et al. 2020), and it appears that curated tools were discarded at workshop sites like Mosquito Ridge rather than the quarry (Milne 2003a:270).

LbDt-1 does not fit the pattern of a typical quarry site located at a significant distance from habitation and workshop sites. The absence of discarded curated tools and middle stage reduction may be related to the use of this site as a "classroom" where young novices were given their first opportunity to break rocks. The focus at LbDt-1 was on procuring chert, but also on teaching young novices to appreciate the value of this resource. This value was instilled by having them transport minimally modified chert over long distances deeper into the interior (Milne et al. 2014). Once the transported chert reached secondary workshop or habitation locations such as Mosquito Ridge, reduction patterns were altered to fit the field processing model. Raw material at these locations was intensively reduced into tool preforms and prepared cores to increase their utility and make them lighter and easier to transport; activities that are normally associated with quarries (Shott 2015:549–550).

Patterns observed through inter-site comparison provide the requisite information to address the hypotheses presented in Chapter 4, which ask about LbDt-1's role in novice flintknapping. The following chapter focuses on interpreting these data in terms of the social relations of production and technological organization of Palaeo-Inuit people on southern Baffin Island.

8. Discussion and Conclusions

This final chapter begins with a summary of the project objectives, and a discussion of which hypothesis is best supported by the results of this study. I then consider the implications of these findings for our current understanding of Palaeo-Inuit lithic technological organization on southern Baffin Island and to Arctic archaeology, more broadly. The chapter concludes with suggestions for future research that would broaden our understanding of lithic technology and skill acquisition for Palaeo-Inuit peoples on southern Baffin Island.

8.1 Summary of Study

The objectives of this study were to investigate the social significance of LbDt-1 as a location where novices first learned to flintknap, and to examine how LbDt-1 fits into the established lithic reduction sequence for southern Baffin Island. These objectives were met by isolating patterns of variability in the LbDt-1 debitage assemblage using the methods of aggregate and individual attribute analyses, and then comparing those results to the debitage assemblages of four Pre-Dorset sites known as Mosquito Ridge (MaDv-11), Sandy Point (LlDv-10), Shaymark (KkDn-2), and Tungatsivvik (KkDo-3). Comparisons were made using descriptive statistics, chi-squared tests, and Levene's test for homogeneity of variance. The results of these comparisons were then considered using a technological organizational framework and agency theory.

The comparison found that LbDt-1 represents an earlier stage in the reduction continuum than any of the other four sites. This is entirely expected as LbDt-1 was known to have been used as a quarry where chert toolstone was procured (Landry et al. 2020:158; Milne 2013:23; Milne et al. 2014). LbDt-1 was also found to have a much higher incidence of evidence for novice flintknapping in comparison to any other site in the study, as indicated by debitage attributes representing patterns associated with low technological skill. This is also expected since quarries have long been inferred as the most ideal locations for novices to learn to flintknap because raw material is readily available thus mistakes made will not pose risks to the group's supply of toolstone (Bamforth and Finlay 2008:17; Cunnar 2015:135; Eigeland 2011:136; Goldstein 2019:685). Milne's (2003a, 2012) earlier research found that early stage lithic reduction and novice flintknapping activities were restricted to the interior region, while tools were completed and maintained on the coast by experts. The results of the current study lend additional support to Milne's conclusions. The results of the LbDt-1 debitage analysis support Hypothesis One outlined in Chapter 4, which argues that: "LbDt-1 was an important place for Palaeo-Inuit novices to gain practical experience in flintknapping, and that the site was a significant source of lithic raw material for Palaeo-Inuit people occupying Mosquito Ridge (MaDv-11), Sandy Point (LlDv-10), Shaymark (KkDn-2), and Tungatsivvik (KkDo-3)."

8.1.1 Site Interpretations

Although the debitage patterns identified at LbDt-1 conform with the expectations of a typical quarry in some ways, it is interesting that these patterns also contradict the predictions of the field processing model. LbDt-1 is isolated and located over 100 kilometers from the nearest known Palaeo-Inuit habitation sites located on the north shore of Mingo Lake. The field processing model indicates that any quarry that is more than a 20-30 kilometer round-trip from a habitation site should have a high incidence of middle and late stage debitage because tools would be reduced to a greater extent at the quarry to facilitate the transport of more usable material in fewer trips (Beck et al. 2002). This is not the case at LbDt-1, where middle and late stage debitage are completely absent, as are discarded tools indicative of retooling activities

(Andrefsky 1994:23; Gramly 1980:826). Based on preliminary analysis of a small debitage sample, Milne and colleagues (2014) suggested that this unusual pattern of use at the LbDt-1 quarry may have been related to the way that Palaeo-Inuit groups structured their lithic apprenticeships. They argued that having the youngest novices transport minimally modified chert nodules over 100 kilometers would instill an appreciation for the value of toolstone (Milne et al. 2014). This exercise would also serve to teach them the importance of reducing chert in advance of the long trip back to their coastal camps. The patterns identified in this study of LbDt-1 support Milne and colleagues' (2014) hypothesis. Taking this idea one step further may also explain the difference in lithic assemblages from the two components of LbDt-1. Analysis of the LbDt-1 assemblage found that a greater frequency of debitage and cores with novice attributes were present on the lower component compared to the upper component. This may reflect that lithic apprentices working at LbDt-1 were split into two groups. The inexperienced (i.e., first time) flintknappers may have worked on the lower component focusing primarily on testing nodules to determine their quality, while the more experienced novices (i.e., those who had visited the quarry in previous years) who had demonstrated that they knew how to select a good quality nodule worked on the upper component practicing early stage reduction, perhaps with more supervision from experts. Once the task group who travelled to the quarry rejoined the main group at an interior habitation site, the more experienced apprentices may have continued to be permitted to flintknap, but with more instruction from experts to prevent material loss, as chert would be less available at these locations (Milne et al. 2014). The continuation of novice flintknapping activities at the interior habitation sites is supported by the presence of lithic debitage and tools with attributes indicative of low skill at Mosquito Ridge and Sandy Point (Milne 2003a, 2005). The younger novices were likely redirected to learn other skills such as snaring or netting snow geese, harpooning caribou in lakes, fishing for Arctic char, or butchery at these habitation sites rather than flintknapping to prevent unnecessary waste of the more limited chert supply (Milne 2005:341).

Analysis of the LbDt-1 lithic assemblage indicates that quarry sites were socially significant as locations where time was scheduled to allow novices to practice flintknapping in an atmosphere where the social relations of production were relaxed and novices could interact freely with their peers, expert flintknappers, and with chert toolstone. These trips to the interior were important not only for the education and enculturation of young members of the social group, they were also important opportunities for members of dispersed groups to come together to socialize, share news, strengthen inter-generational bonds, reaffirm connections with distant friends and relatives, and to meet potential spouses (Milne 2014:109).

8.2 Implications for Arctic Archaeology

This research is the first detailed analysis of a chert quarry located in the eastern Arctic. As such, this study provides a glimpse into the importance of lithic quarries to Palaeo-Inuit peoples as sources of this vital resource. This study also facilitates interpretations of the significance of such sites in the enculturation process and in structuring other socially meaningful activities such as maintaining connections between dispersed groups.

Prior to the identification of two chert quarries (LbDt-1 and LdDx-2) in 2013, uncertainty surrounded the source of toolstone for Palaeo-Inuit people occupying southern Baffin Island (Landry et al. 2020:156). Up to that time it was thought that chert was primarily acquired at secondary deposits scattered throughout the interior region (Milne 2005:338; Milne and Donnelly 2004:102). While Milne's (2003a, 2012) research has provided a good understanding of how this important resource was used and transported between the interior and coastal regions of southern Baffin Island, the earliest phase in the lithic reduction continuum, that of procurement and material testing, could not be thoroughly explored as primary extraction/acquisition sites or quarries had not yet been identified. This study of lithic debitage from LbDt-1 provides the missing early stage component of the lithic reduction sequence known for southern Baffin Island.

The first contribution of this study is a greater understanding of how Palaeo-Inuit people staged their lithic reduction activities in areas where access to lithic raw material is geologically and seasonally restricted. Despite the long distances lithic raw material had to be transported, the debitage analysis of LbDt-1 demonstrates that quarries in the interior region of southern Baffin Island did not double as workshops. Instead, minimally modified raw material was transported over vast distances from the quarry to secondary workshop/habitation sites in the interior region where nodules were reduced into preforms in preparation for transport to the coastal region. The production of preforms at interior habitation sites results in debitage patterns indicative of intensive tool reduction in preparation for long distance travel. This pattern conforms more to the field processing model than does the quarry assemblage. Previous researchers have suggested two reasons for the separation of these early and middle stages of lithic reduction, each of these reasons are supported by the LbDt-1 assemblage. The first is that the quarry did not have the same access to subsistence resources that are available at the interior habitation sites, making these the more practical locations for longer duration camps (Kelly 1988:718). This is supported by the limited faunal assemblage collected from LbDt-1 consisting of only a few caribou bones. A second possibility is that transporting minimally reduced chert over long distances was an important part of a novice’s lithic apprenticeship, designed to teach novice flintknappers the value of chert (Milne et al. 2014). This is supported by the high frequency of debitage with attributes indicative of low skill identified at LbDt-1.

The second contribution of this research is that it supports the current view that quarries such as LbDt-1 were not only important for the procurement of chert, but also for their role as "classrooms" for Palaeo-Inuit novice flintknappers. Milne et al.'s (2014) preliminary study of the LbDt-1 assemblage identified the presence of novices at the quarry and suggested that quarries such as LbDt-1 were locations where young novices were initiated into their flintknapping apprenticeship and had their first opportunity to break rocks. This interpretation was based on the high frequency of cores and debitage exhibiting flintknapping errors, and the lack of specimens with attributes indicative of proficient skill. Milne et al. (2014) also proposed that these inexperienced novices transported minimally reduced chert nodules to secondary sites in the interior, where debitage and stone tools with attributes indicative of both low and high skill are found. They argue that these secondary habitation/workshop sites would be the locations where older, more experienced lithic apprentices received more instruction from expert flintknappers. These interpretations were supported by this study that investigated the full lithic collection from LbDt-1, which also identified abundant evidence of novice skill. Additionally, the analysis of a large sample of lithic debitage from LbDt-1 allowed the progression of flintknapper skills to be traced across the site. The upper and lower components of LbDt-1 were differentially used by novices, which supports Milne and colleagues' (2014) hypothesis that Palaeo-Inuit lithic apprenticeships on southern Baffin Island were structured into cohorts of novices at different stages of the learning process.

Previous research has identified the interior region, and the seasonal aggregations that occurred there, as significant aspects of the social lives of Palaeo-Inuit people (Milne 2014;

Milne et al. 2013). Milne (2014) outlines three important social functions that would have been fulfilled by seasonal travel between the coast and interior of southern Baffin Island. The first is that it provided an opportunity to reorganize the group. This social reorganization would have relaxed the social relations of production and to allowed people to distance themselves from one another so that inter-personal grievances built up during the winter could dissolve. The second social function of these trips inland was to create opportunities to meet potential spouses and renew connections with distant communities. Lastly, the annual ritual of travelling the landscape served to reaffirm the group's connection to the land. The act of revisiting important places, telling the stories associated with those places, and performing the appropriate actions at the correct locations was one avenue for Palaeo-Inuit people to maintain and reaffirm their culture and to teach younger generations what it means to belong to the culture (Milne 2014:110–111).

Building on these concepts regarding the social significance of inland travel, it is possible to hypothesize that quarries such as LbDt-1 would have also played an important role in the social experience of this group, especially for young lithic apprentices. Burke (2007:64) highlights this idea stating that "[q]uarries are also special places: permanent fixtures on the landscape linking generation after generation of hunter-fisher-gatherers that sought knappable stone for the manufacture of tools that were critical to their survival." Following Burke's (2007:64) idea, it is possible to suggest that LbDt-1 was likely a location that linked generations of flintknappers based on its repeated use over hundreds to thousands of years (Landry et al. 2020:160). Over half (56.6%, n=1830) of the flakes analysed from LbDt-1 can be attributed to novice flintknapping activities. This indicates that novices significantly contributed to the creation of the dense debitage deposit and supports the assertion that novices were brought to LbDt-1 regularly to participate in lithic procurement activities as discussed by Milne and colleagues (2014). Presumably, at least some novices would eventually graduate to the role of experts and would then have lithic apprentices of their own to whom they were responsible for transferring flintknapping knowledge. In their new role, the experts would maintain the inter-generational connection with LbDt-1 by inducting new novices into their lithic apprenticeship at the quarry.

Quarries like LbDt-1 on southern Baffin Island may also have played an important role in maintaining connections between distant communities. Goldstein's (2019:706) research on Elmentetian lithic novices in southern Kenya suggested that participating in a flintknapping apprenticeship at the quarry with peers from distant communities would create circumstances for novices to develop social bonds with each other and their instructors. It is conceivable that Palaeo-Inuit novices from distant coastal communities on southern Baffin Island similarly would have travelled together to the quarry with expert flintknappers during warm season aggregations to participate in chert procurement as part of their lithic apprenticeship. Learning to flintknap alongside peers from other communities at the quarry and traversing the long distances between the quarry and the habitation/workshop sites while carrying heavy burdens of minimally reduced chert would certainly be a memorable experience that would encourage social bonding between the novices. These bonds would be strengthened as novices regularly returned to the quarry to continue their lithic apprenticeship. The social relationships forged by young people during these trips to the quarry would ensure the maintenance of positive relationships between communities as the apprentice generation replaced their elders (Goldstein 2019:706–707).

8.3 Future Directions

This research on LbDt-1 has provided the missing acquisition and testing portion of the lithic reduction sequence on southern Baffin Island and insights into how Palaeo-Inuit flintknapping apprenticeships and quarry use was structured. However, LbDt-1 was not the only quarry used by Palaeo-Inuit people on southern Baffin Island. Two other quarries are known (LdDx-2 and LbDt-2), and more will surely be identified during future surveys of the interior and intermediate regions of southern Baffin Island. Investigations at these and other as yet unknown quarries will reveal if the patterns associated with novice flintknapping identified at LbDt-1 are consistent among all Palaeo-Inuit quarries in the region or if they are unique to this site.

One aspect of novice flintknapping that would be particularly interesting to investigate at Palaeo-Inuit quarries is the role of quarries in inter-community information exchanges. During warm season aggregations novices from distant communities may have travelled together to a quarry to be taught by expert flintknappers. If there was a structured inter-community lithic apprenticeship tradition, it would mean that young people from distant communities on southern Baffin Island could be taught by the same teachers using the same techniques. This standardized instruction would lead to a certain level of conformity in stone tools across the region and may explain in part why Dorset tools are "compulsively standardized" (Maxwell 1985:127; Quinn et al. 2019:721). This coordinated knowledge transmission could also be one reason why when the style of a tool changed in one part of the eastern Arctic, those changes were quickly adopted across the whole region (Maxwell 1985:4; Milne 2014:111). A similar situation has been documented in southern Kenya, where Goldstein's (2019) research on Elmenteitan novices learning to produce obsidian blades suggested that lithic apprentices from dispersed communities travelled to the quarry with experts to learn flintknapping. Goldstein (2019:706) suggests that this centralized learning at the quarry provides an explanation of how Elmenteitan lithic technology remained unchanged over a vast and varied landscape for the span of 2000 years. He argues that lithic apprenticeship may have been part of a social system engineered to maintain inter-community relationships, and that commitment to connectivity may be one reason for the "remarkable homogeneity" in Elmenteitan lithic tools (Goldstein 2019:707).

This idea could be explored at Palaeo-Inuit quarries through debitage analysis. If quarries were found to be differentially used with some displaying debitage patterns similar to LbDt-1, and others more closely aligning with the expectations of the field processing model, these patterns could be interpreted as certain quarries being selected for initiation of aggregated novices, while others were used for more efficient toolstone procurement. Alternatively, if every quarry has similar frequencies of novice participation it would suggest that communities trained their own novices rather than having them learn alongside peers from other communities. Another possible way to investigate if lithic apprentices from different communities learned together would be to analyse stone tools from distant sites to determine if they were produced using the same flintknapping techniques. If they were, it would support the notion that novices from distant communities learned from the same instructors. Stone tools change in form through use and curation practices, thus in situations where the initial flintknapping techniques used to produce stone tools are difficult to identify, geochemical signatures of chert tools could also be incorporated to determine if novices in different regions were procuring their toolstone from the same source.

Although analysis of the LbDt-1 debitage assemblage has nearly completed the lithic reduction sequence for southern Baffin Island, a missing piece remains. None of the sites included in this study were occupied in the winter. While we can speculate that lithic activities in the winter would have been limited to tool maintenance and liquidation performed by experts owing to the limited access to toolstone in winter conditions (Maxwell 1973:11), we currently lack debitage from these sites to confirm this. There is ample evidence for tool liquidation and maintenance in the Shaymark assemblage, indicating that expert flintknappers were extracting all the utility they could from the material they had on hand (Milne 2012:131–132), thus we know this was a common practice among Palaeo-Inuit and similar patterns can be expected at winter habitation sites. Future excavations at winter habitation sites may provide the material required to investigate questions related to lithic reduction strategies and novice activities at winter sites.

Although we currently lack evidence for lithic activities at winter sites, connections between known sites can be investigated through chert sourcing studies. Geochemical analysis of chert from LbDt-1 and LdDx-2 has determined that they have unique signatures, which has allowed chert from these sites to be identified at other locations. A comparative study of Tungatsivvik (KkDo-3) debitage found that chert from both LbDt-1 and LdDx-2 was transported to the site (ten Bruggencate et al. 2017:659). Similar chert sourcing investigations using debitage samples from Mosquito Ridge (MaDv-11), Sandy Point (LlDv-10), and Shaymark (KkDn-2) may provide additional evidence linking these sites with LbDt-1.

One potential problem with this study that could be addressed through additional research is that only Pre-Dorset sites were used for comparison with the LbDt-1 assemblage. While the presence of possible burin spalls at LbDt-1 suggests that the site was used by the Pre-Dorset, there is no reason to suggest that it was not also used by the Dorset (Milne 2013:23; Milne et al. 2014). Geochemical sourcing has successfully identified chert debitage recovered from Crystal II (KkDn-1) as having originated at the interior quarry site LdDx-2. This site has a complicated occupation history with Pre-Dorset, Dorset, and Thule components and it is entirely possible that the chert sample tested was from the Dorset occupation, but this cannot be stated with confidence (ten Bruggencate et al. 2017:653, 659). Research similar to the current study using Dorset sites for comparison would provide interesting insights into differences and similarities in quarry use between the two groups. Landry's (2013) thesis that focused on the lithic assemblage from LdFa-1 indicates that this site was a Late Dorset workshop/habitation site with a similar assemblage to that of Mosquito Ridge. This suggests that the pattern of quarry use between the Pre-Dorset and Dorset was probably similar, with minimal early stage reduction taking place at the quarry, followed by more intensive reduction at habitation sites. However, further investigation involving detailed comparisons with Dorset sites are required before any conclusions can be made regarding Dorset quarry use on southern Baffin Island.

Lastly, the tent rings observed at LbDt-1 have not been considered in this study. Little time has been spent addressing them because they cannot be explicitly connected to activities associated with the quarry as they are located approximately 300 meters east of the main quarry deposit (Landry et al. 2019; Milne 2013:26). One test pit was excavated in two of the five tent rings on the upper component to try to identify their cultural affiliation, but only debitage was recovered (Milne 2013:26). The presence of so much debitage inside the tent rings is unusual. LbDt-1 was occupied during the warm season, thus flintknapping activities are expected to have occurred outside of the tent where there would be better light, unless the weather was poor or the bugs were particularly bothersome (Milne 2003b:81). If flintknapping activities did take place inside of these tents, it would be expected that the larger pieces of debitage would have been cleaned out leaving only micro-debitage within the tent ring (Milne 2003b:83). Debitage representing all size grades was recovered from the test pits, so this does not appear to have been the case for these tent rings. This debitage pattern suggests that the tent rings are more likely associated with later Thule or Inuit groups, who built their tent rings on top of the existing debitage deposit and were not concerned with being close to the limestone outcrops from which chert could be obtained. It is possible that additional excavations of the tent rings may confirm their cultural affiliation and provide a clearer chronology of the site. However, this is unlikely as no diagnostic tools were identified on the surface or in any of the excavated test pits. Further excavations at LbDt-1 may provide more information regarding the site's use as a novice training ground and about who used it.

This study has added to our overall understanding of Palaeo-Inuit chert procurement strategies on southern Baffin Island and how novices were involved in this activity. It has provided insight into the social importance of quarries as places where novices embarked on their journey towards adulthood, and reaffirmed and strengthened bonds between communities and generations of Palaeo-Inuit on southern Baffin Island. The unusual use of LbDt-1 which contradicts the predictions of the field processing model, favouring the instruction of novices over optimality may be informative to researchers working in similar environments where raw material access is geologically and seasonally restricted.

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Appendix A: Lithic Debitage Attribute List and Definitions

Introduction

The attributes used for debitage analysis in this study are detailed below. This attribute list is a modified version of the one used by Landry (2013), who in turn had modified Milne's (1999, 2003a) attribute lists. The list has been altered to reflect the different method of material collection used at LbDt-1, and to be more specific to the research questions that were the focus of this project.

Debitage Identification

Site Designation

(1) LbDt-1

Component

Discussion of different spatial areas within LbDt-1 was facilitated by splitting the site into two discrete components.

(1) Upper
(2) Lower

Collection Year

Debitage was collected from LbDt-1 over two field seasons. The year of collection was recorded to make it easier to connect locations of collection to field notes recorded during each site visit.

(1) 2013
(2) 2015

Unit

LbDt-1 was not systematically excavated. Therefore, the unit category describes the label written on the bag in which the artifacts were placed at the time of collection.

(1) Surface collection from boulder

(2) Riverbank slump from 2013 test

(3) Surface nodule

(4) Test 1, NW of geophysical grid ~17 m

(5) Test 2, inside 6/20 meter geophys grid, 25x25 cm

(6) Test 3, 15x8 geophys grid, 25x25 cm

(7) Random raw chert from outcrops

(8) Test 4, NW quad, cat 4, rapids site (lime 4) Riverbank slump, 2013:39

(9) Tent ring 1, test pit 1, cat 2, rapids site / lime 4, 2013:36

(10) Rapids site, lime 4, collection from riverbank, 2013:35

(11) Test 1, NW Quad, cat 1, rapids site (lime 4), 2013:38

(12) Tent ring test pit 3, SW quad, Cat. 3, rapids site (lime 4), 2013:38

(13) Surface flakes, rapids site (lime 4), 2013:33

(14) Surface collection, rapids site (lime 4), 2013:34

(15) Surface collection

(16) 2013:32

(17) Test 4, rapids site (lime 4), riverbank slump, 2013:40

Artifact Number

Each debitage specimen was given an artifact number as a unique identifier within the catalogue. These numbers are arbitrary, they simply reflect the order in which artifacts were added to the dataset and do not maintain any value for future researchers.

Raw Material Attributes

Raw Material Type

LbDt-1 is a chert quarry. As such, few examples of other lithic raw materials are expected in the debitage assemblage for this site. Raw material type therefore is simply recorded as:

(0) Indeterminate
(1) Chert
(2) Other

Raw Material Quality

The quality of the raw material is classified as either poor or good. Poor-quality material is that which contains voids, vugs and fossil or other inclusions. Good-quality material is fine-grained, homogenous and has no inclusions, cracks or voids (Andrefsky 2005:24).

(0) Good – inclusions, voids, cracks, or vugs are absent
(1) Poor – inclusions, voids, cracks, or vugs are present

Technological Attributes

Debitage attributes that provide insights into the technological choices made by flintknappers include: weight, size, dorsal cortex cover, dorsal scar count, platform modification, platform battering, bulbs of percussion, compression rings, and eraillure scars (Landry 2013:49). These attributes assist in determining which stage of the reduction sequence a flake was detached, the type of hammer or percussor that was used in its production, and information regarding the skill of the flintknapper (Cotterell and Kamminga 1987; Hayden and Hutchings 1989; Shelley 1990).

Dorsal Cortex

The amount of cortex observed on the dorsal surface of flakes provides insight into when in the reduction sequence they were removed from the objective piece (Ahler 1989a:90; Andrefsky 2005:103). This attribute also indicates the size of the initial nodule that was reduced (Bradbury and Franklin 2000:45). To estimate this variable, the following ranges were used to describe the percent of cortex retained by the flake:

(0) 0%

(1) 1-25%

(2) 26-50%

(3) 51-75%

(4) 76-99%

(5) 100%

These categories were later compressed to be more directly comparable to Milne's (2003a) data as follows:

(0) 0%

(1) 1-50%

(2) 51-99%

(3) 100%

Size Grade

The debitage collection was divided into size grades following Carr and Bradbury's (Andrefsky 2007:399; Carr and Bradbury 2004:28) recommendation of "hand manipulating" each piece of debitage through USA Standardized Test Sieves. Initially a size grade "0" was included which encompassed anything that could fit through the 3.35 mm mesh. This category was merged with the size grade "1" category prior to analysis to make my data directly comparable to Milne (2003a). The screen sizes are as follows:

(1) Size Grade 1: <6.3 mm
(2) Size Grade 2: 6.3> <12.5 mm
(3) Size Grade 3: 12.5> <19 mm
(4) Size Grade 4: 19> <25 mm
(5) Size Grade 5: 25> <31.5 mm
(6) Size Grade 6: >31.5 mm

Weight

The weight of each piece of debitage was recorded using a standard lab scale that was level to the table and reset between each measurement. The weight was recorded to 1/100th of a gram.

Dorsal Scar Count

Like the percent of cortex, the number of dorsal scars present on a flake provide information regarding when in the reduction continuum the flake was removed from the objective piece (Andrefsky 2005:106). These scars were counted using a combination of visual and tactile senses, sometimes with the aid of a magnifying glass or loupe. Flakes related to platform preparation or battering are not included in this count (Andrefsky 2005:109).

Platform Modification

These states are differentiated by the number of facets present on the platform and by the presence of features such as trimming or grinding.

(0) Platform absent: The platform will be recorded as absent in cases of shatter or when a flake fragment lacks a platform (i.e., medial-distal flake fragments).

(1) Unmodified: Platforms are considered unmodified when they retain cortex (Andrefsky 2005:94).

(2) Crushed: These platforms tend to be “saddle-shaped” having a concave appearance or have evidence of fragmentation. These platform types often result from bipolar reduction (Ahler 1989b:210).

(3) Minimal: Platforms that are flat and have a single facet. These flakes are typically removed from unidirectional cores (Andrefsky 2005:95).

(4) Moderate: These platforms have one or two flake scars present, which may be accompanied by trimming or grinding. These platforms may have a convex appearance (Andrefsky 2005:96–97).

(5) Advance: These platforms have two or more flake scars present. Grinding or abrading may also be evident, which will be evident though visible striation marks or from the texture of the platform (Andrefsky 2005:97). Advance platforms represent a greater investment in time and energy and are associated with late stage reduction and with greater levels of flintknapping skill (Cotterell and Kamminga 1987; Milne 2005; Shelley 1990).

Platform Battering

(0) Absent: There is no evidence of repeated strikes to the platform, detachment was achieved with a single blow. Or the platform itself is absent.

(1) Stacked: Stacked step fractures located below the platform result from repeated strikes to the same location and are indicators of novice skill (Shelley 1990:188).

(2) Feather: Feather terminations below the platform indicate that the platform was trimmed in preparation for flake detachment (Shelley 1990:192).

Bulb of Percussion

The bulb of percussion is recorded as either absent, or present.

(0) Absent: Flakes are recorded as having absent bulbs when none can be detected visually or through tactile examination. Flakes lacking bulbs are often the result of bipolar reduction or are "bending flakes" where the fracture occurs away from the point of impact (Andrefsky 2005:26, 28; Goodyear 1993:6), they can also occur at tool edges during tool use as pressure is moved into the tool body (Cotterell and Kamminga 1979:102).

(1) Present: If a bulb can be detected either visually or through feel it will be recorded as present. Bulbs tend to be most pronounced on flakes with obvious platforms and result from percussion flaking rather than pressure (Barnes 1939:109; Cotterell and Kamminga 1979:102).

Compression Rings

Like the bulb of percussion, compression rings are recorded as *absent or present.*

(0) Absent: Compression rings are recorded as absent when they are not visible under any lighting conditions and cannot be felt through tactile examination.

(1) Present: If compression rings are visible on the flake's ventral surface or can be felt with the thumb they will be recorded as present.

Eraillure Scars

Eraillure scars occur on the bulb of percussion, here they are simply recorded as present or absent.

(0) Absent

(1) Present

Post-Depositional Attributes

Attributes considered post-depositional include debitage completeness and distal termination. Debitage completeness documents the transformations that debitage undergoes after it becomes part of the archaeological record. These attributes reflect fracturing owing to trampling or other site formation processes (Nielson 1991; Prentiss and Romanski 1989:94). Debitage completeness was recorded based on Sullivan and Rozen's (1985:759) interpretation free debitage categories. This method applies mutually exclusive attributes to classify the degree of debitage completeness.

Debitage Completeness Index

The level of debitage completeness is defined as follows:

(1) Shatter: Any item that lacks definitive flake features but is clearly the result of lithic reduction. Shatter is typically irregularly shaped, chunky, lacks a bulb of percussion and cannot be oriented to the direction of force (Ahler 1989b:210).

(2) Medial - Distal Fragment: This category includes flake fragments that lack platforms but have recognizable distal terminations.

(3) Split: Split flakes are broken longitudinally and may have portions of both the platform and the termination.

(4) Proximal Fragment: This group includes flake fragments where the platform is present, but the termination is incomplete (indeterminate, step or snap).

(5) Complete: These are unbroken flakes that have all their features available for analysis and have a complete termination i.e., feather or hinge.

Distal Termination

(0) Indeterminable / Absent Terminations: This is simply a lack of any discernable termination. Shatter and proximal flake fragments will fall under this category.

(1) Feather Terminations: When viewed in profile, flakes with feather terminations slope continuously to their termination point (Cotterell and Kamminga 1979:104–105).

(2) Step Terminations: These terminations are recognized as an abrupt 90˚ angle at the distal end of the flake and they will often have a little material hanging below the break, making it a little rougher than seen in snap terminations. This is owing to their incomplete detachment from the objective piece (Cotterell and Kamminga 1987:700). These occur when the force applied is insufficient to completely remove the flake from the objective piece or when a flaw in the raw material is encountered which stops the wave energy from moving through the material (Cotterell and Kamminga 1979:105–106).

(3) Hinge Terminations: When viewed in profile, flakes with hinge terminations slope continuously to their termination point but unlike feather terminations these flakes will

curve into themselves at the termination point, resulting in a thicker, blunter, rounder termination (Cotterell and Kamminga 1979:104–105). These terminations occur when less force is applied than is necessary for the flake to detach or when the flake is removed from a relatively flat surface (Cotterell and Kamminga 1987:700).

(4) Outrepassé Terminations: This termination type occurs when the force is applied too far from the edge of the objective piece causing the fracture to occur on the other side of the core (Cotterell and Kamminga 1979:106). These terminations remove large parts of the objective piece at its distal end and therefore the flakes tend to be thick and curve in a J-shape towards the ventral surface (Andrefsky 2005:87).

(5) Snap Terminations: These are a subset of step terminations; they are recognized as abrupt 90˚ angles. These terminations are distinguished from step terminations by their very “clean” break because they have completely detached from the objective piece (Cotterell and Kamminga 1987:700). These can occur when the flake is too thin and snaps when it is detached from the objective piece (Cotterell and Kamminga 1979:104–105).